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Brilliancy and Composition of Glassware

How to Calculate the Brilliancy of Hollow and Cut Glassware Before It Is Made

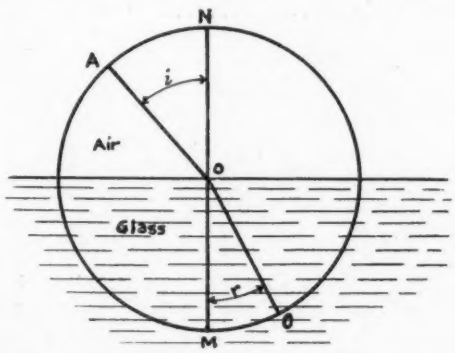
By Oscar Knapp*

Users of different kinds of glassware require certain definite properties of the goods delivered. In many cases, these requirements are extremely severe and their fulfillment can only be accomplished through the application of the advances made in modern theoretical and applied physics and chemistry. Requirements of this character are for instance in optical glass, definite optical properties; in chemical glassware, perfect resistance against the action of chemicals; in cooking glassware, high resistance against sudden changes in temperature; in electric light bulbs, a fixed coefficient of expansion. The manufacture of such special glasses is much more difficult for that reason, and requires, aside from experience in glass manufacturing, a considerable theoretical knowledge.

In the case of hollow ware and cut glassware, the physical or chemical requirements are not fixed. Dealers and users of this kind of glassware demand only good outward appearance, such as beauty, an agreeable shape, a pure and pleasing color—or complete freedom from color—and a high degree of brilliancy. Of the properties enumerated, the latter is the most important; a glass of great brilliancy appears to the observer to be more fiery and more free of color.

The brilliancy of glass is dependent on its index of refraction. The greater the index of refraction of a glass, the more limpid and the more brilliant it appears. For this reason, if a manufacturer of hollow ware or cut glassware desires to produce glass with a high degree of brilliancy, he must manufacture a glass with a high index of refraction. In his choice of glass batches, he must select the one, which, all other things being equal, will yield a glass with the highest power of refraction.

Under power of refraction is understood the property of transparent material to change the direction of incoming light rays.[1] For instance, if a ray of light penetrates a glass object, it is deflected from its course, and the direction of the ray is changed on leaving the glass. The angle between the direction of the ray and a line perpendicular to the surface of the glass, is called the angle of incidence (i in Fig. 1).



The deflected ray of light forms the angle of refraction r. The ratio of the sine of these two angles is constant for a definite kind of glass, and is characteristic for every variety of glass. This ratio is called the index of refraction. It is different for the various colors of which sunlight is composed. For the sake of comparison, glasses are classified according to the index of refraction of yellow light, emitted by sodium vapor. The index of refraction for sodium vapor light is therefore:

$$n_D = \frac{\sin i}{\sin r}$$

It has been known for a long time that certain batch materials give to glass a high power of reflection. Glasses made with lead have an exceptionally high refractive power, and for this reason are of a high brilliancy. The high power of refraction of barium glasses was also known in the seventies of the past century.

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[1]The law of refraction was discovered by the Dutch physicist Snell about 1620, and may be thus stated:

When light passes from one medium into another, the ratio of the sine of the angle of incidence to the sine of the angle of refraction is constant for light of any given wave length, whatever may be the inclination of the incident beam; and the incident, reflected and refracted rays are all in the same plane, called the plane of incidence which is normal to the surface.

In order to study the relationship between power of refraction and chemical composition, Zschimmer has melted a series of glasses. He found the following rule: The value of the index of refraction grows with the increase of the molecular weight of the glass forming oxide used. This proportionality, however, is not direct. In the case of the lighter oxides the deviation is small, for the heavier oxides it is larger than would be the case if the proportionality were a direct function.

Peddle also has made a series of experimental melts, the result of which have made possible the calculation of the index of refraction by means of interpolation. A general law has as yet not been established.

In the study of the relationship between refractive power and chemical composition, the author has succeeded in fixing a direct proportionality between these two factors. According to this view, the power of refraction of glass is an additive property of the refractive powers of the glass forming oxides. The index of refraction of glass, then, can be calculated from the indices of refraction of the glass forming oxides by means of the following equation:

$$n_D = a_1 n_{D_1} + a_2 n_{D_2} + a_3 n_{D_3} + \ldots\ldots\ldots\ldots\ldots\ldots \text{etc.}$$

in which a_1, a_2, a_3, ... etc., represent percentages by weight and n_{D_1}, n_{D_2}, n_{D_3}, ... etc., represent the refractive indices of the glass forming oxides. These values for the components of hollow ware are as follows:

SiO_2	0.01467
Na_2O	0.01575
K_2O	0.01551
CaO	0.01776
MgO	0.01655
Al_2O_3	0.01581

In order to prove the correctness of this law, the following table may serve, in which the values found by experiment, and those obtained by calculation are given side by side:

No.	SiO_2	Na_2O	K_2O	CaO	(Found) n/D	(Calc.) n/D	Difference
1	56.6	23.1	...	20.3	1.554	1.556	0.002
2	63.5	27.6	...	8.9	1.526	1.525	0.001
3	64.4	12.7	...	22.9	1.557	1.552	0.005
4	66.4	27.4	...	6.2	1.519	1.516	0.003
5	79.9	16.5	...	3.7	1.497	1.498	0.001
6	50.1	...	31.3	18.6	1.548	1.551	0.003
7	55.1	...	34.6	10.3	1.528	1.528	0.000
8	59.3	...	18.6	22.1	1.549	1.551	0.002
9	56.5	...	35.6	7.9	1.523	1.521	0.002
10	68.9	...	21.5	9.6	1.515	1.515	0.000
11	52.9	16.5	10.9	19.7	1.551	1.555	0.004
12	71.5	11.2	7.4	9.9	1.518	1.516	0.002
13	73.9	11.6	7.6	6.9	1.509	1.507	0.002
14	76.5	12.0	7.9	3.6	1.499	1.497	0.002

As may be seen from the above figures, the differences between the calculated and found values are small.

With this rule we are able to calculate the power of refraction of glasses in advance. Since however the refraction and the brilliancy are closely related, these figures are at the same time indicative of the property of brilliancy. With the aid of the above formula the manufacturer of hollow ware and cut glass can calculate the brilliancy of his glass before it is made, and can select a batch which will yield a glass of the greatest brilliancy, by means of a simple calculation.

The Deformation of Glassware Due to Unequal Cooling During Manufacture

By Roy E. Swain*

All the ordinary glasses contract so much in cooling that a pressed or blown article will "shake" considerably if replaced in the mold after both the mold and glass have cooled to room temperature. If it were possible to cool the glass uniformly the manufacturer could have "shrink rules" made for his different glasses and have his molds made to these rules. However, glass being a poor conductor of heat the cooling is seldom if ever uniform, and the contraction that takes place usually causes some deformation of the article as well as the linear shrinkage.

This unequal cooling, while more pronounced in ware shaped in molds, is not limited to such, as will be seen in considering the window glass roller or cylinder. When a cylinder is split in preparing it for flattening, the edges will overlap unless prevented by some sort of clamp. This overlapping is caused by the stresses in the glass due to the unequal cooling of the inner and outer layers of the roller. The outer layer of glass being exposed to the circulating air of the blowing room, cools to the congealing temperature while the inner layer is still viscous, clinging to this outer shell of congealed glass. The contraction of this outer shell, due to cooling, puts the inner layer in a state of thrust. This inner layer is in a semi-liquid state and readjusts itself to relieve this stress. As the cooling proceeds this layer of congealed glass thickens until all the glass in the cylinder has congealed. At this time, so far as stresses are concerned, an approximately neutral condition exists. There is, however, quite a temperature difference between the outer and inner layers of glass. As the cylinder cools this temperature difference gradually disappears. Since the inner layer is required to cool through a greater range to room temperature, it tends to contract to a greater extent than the outer layer. This produces a state of thrust in the outer layer and a state of tension in the inner layer. When the cylinder is split the tension of the inner layer of glass causes the edges to overlap and reduces the size of the circle. These rollers are quite large and the overlapping so great that the effects of unequal cooling are easily seen. In some smaller articles gauges and templets are necessary to find the deformations caused by the unequal cooling. Often considerable study is required to trace deformations back to their causes.

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Warping of Pressed Ware

Nearly every press house has a number of flat jobs and experiences more or less trouble in keeping these from warping. Usually such ware "cups" on the plunger side. The explanation for this is the same as offered for the overlapping of the edges of the cylinder. The glass is placed in the mold which immediately begins to draw heat from the glass, forming a layer of congealed glass on the mold side of the gathering. The mold is placed beneath the plunger and pressed. The plunger forms a skin of congealed glass on the upper surface of the article. This is a relatively thin skin as the plunger is in contact with the glass but an instant. By placing the ware while still in the mold under a blast of wind to hasten cooling and consequent contraction of the upper surface, the edges will be lifted clear of the mold by the tension of this upper layer of glass. This tendency is sometimes utilized by slipping a thin instrument under the glass to remove it from the mold. This small amount of utility does not, however, compensate for the trouble caused by the warped ware.

When the article is "finished" the temperature of the two surfaces can be so balanced that they will practically neutralize each other as the article cools. Another method sometimes employed is to fire-finish the mold side of the article by placing the plunger side on a former or a paddle and directing a blast onto the mold side. This will usually cause the mold side to cup slightly. This cupping is not as objectionable as a crown or convex surface would be, especially on combination window display racks and similar articles which may be called upon to rest upon or support an object having a flat surface.

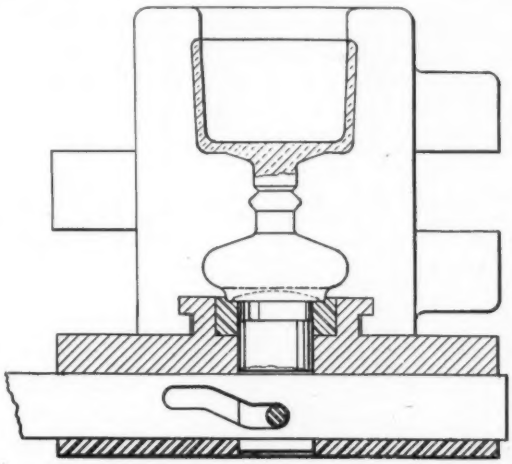
Sometimes it is not practicable to finish an article, yet the ware must be reasonably flat. One rather heroic method has been developed for such cases and its use has brought excellent results. This method consists of blowing a blast of wind on the plunger side to give this side as nearly as possible the same chill as the mold side. This causes the edges to curl. The ware is then turned out on a hot plate and a plate or weighted ring is placed on the article to force it back to flatness while it is still pliable. Needless to say to get good results quick work and good judgment are required. When flattened the skin or chill thickness is about equal on each side of the article and so each is able to neutralize the other in its tendency to warping during the remainder of the cooling period.

Many articles such as mast heads whose thickness varies greatly in adjoining sections "suck" on the straight side opposite the projections. By running one's hand down the inside of a mast head an idea can be gained as to how serious the problem of obtaining exact dimensions or contour can become when confronted with the possibilities of contraction during manufacture.

There are two reasons for the inside surface deforming. First, this being the plunger side only a thin skin is formed as compared with the outer or mold side. This thin skin quickly reheats and "gives" easily to the pulling of the contracting interior. Second, the outer surface is so arched as to resist any pressure brought to bear upon it.

When an article such as a mangin mirror is pressed it is desirable to keep the grinding and polishing costs at a minimum. To do this it is necessary to keep the concave and convex surfaces free from any sinking or sucking. This is done by localizing the sucking, the ring being swung on the spring plate so that the ring is lifted as the plunger is removed, giving the hotter glass that is forced into this upper section an opportunity to reheat this upper surface and take care of the sucking action. A cooling blast on the inside of the ware helps to hold the inner curvature. This ring surface whether ground, flat or beveled requires comparatively simple grinding equipment.

A great many articles are made in font or well molds to be finished by grinding and polishing. Very often a shrinkage pad can be added to the article so as to localize the shrinkage and a fairly presentable article can be secured by grinding



DOORKNOB MOLD, WITH SHRINKAGE PAD

and polishing one surface and removing the gate. The accompanying rough layout of a mold for a common door knob shows one way of doing this. Here the shrinkage pad is placed on the bottom in the valve, and the valve is withdrawn from contact with the glass as soon as it is pressed, permitting this surface to reheat and feed the interior as it contracts. The same effect can be secured by working a number of shells with a single bottom plate, as lifting the shells off the bottom plate is equivalent to dropping the valve. Any number of different molds can be laid out to incorporate this principle; some may be more complicated or difficult to operate than others but still be justified by the saving in the finishing operation.

"Magic Blisters"

In pressing font mold ware it is usually necessary to break the key or release the mold in some way almost as soon as the mold fills, to prevent the formation of "magic blisters" through the central portion of the article. Such blisters are quite common in very small articles where it is difficult to get the mold unlocked quickly. They are common in pressed stem ware, especially where there are constrictions in the stem or if the stem has a round cross section. Blowing wind on the ware increases the possibility of these blisters forming as does also the working of a cold mold.

When first observed these blisters are apt to puzzle the

workman especially when he sees them growing or finds them in his ware coming off the lehr when he is sure that they were not there when he sent the ware in. An explanation is easily given, for here we have a tube or form of congealed glass containing molten glass. As this molten glass cools it contracts until it no longer fills the tube or container of chilled glass. This unoccupied space naturally takes the shape of a sphere which later may become modified by piping should the article have an irregular shape. Here we have what is usually considered a vacuum blister. This blister may be filled with some gas held in solution in the glass, but will disappear when the glass is heated to the softening point.

American Ceramic Society Convention Papers

Reviews of Authors' Contributions to the February Meeting in Detroit

Design and Service of Tank Blocks

BY DONALD W. ROSS, WASHINGTON, PA.

Aside from the wearing away of tank blocks by gradual solution by the glass, tank life in general depends largely upon four features:

1. Cracking of the inner face of the blocks during heating or early life, due to shrinkage of the face of soft burned blocks, thus presenting many downward facing surfaces.
2. Cracking of the blocks during heating or early life of the tank, as evidenced on the outside of the tank.
3. Cutting through at the metal line.
4. Failure at the bridge or throat.

CRACKING

Shrinkage cracking of the interior face of blocks during heating up and during use has been covered by articles by Geller, Flint, and Ross, published in the *Journal American Ceramic Society*. Blocks may crack entirely through. Such cracks are plainly visible on the outside of the tank while it is in operation and their disastrous effects to the inside of the tank are apparent after the tank has been let out. Breaking of tank blocks during heating of tanks is often caused by pressure from the expansion of the blocks against the supports. Breakage from thermal causes occurs mostly between 800 deg. F. and glass melting temperatures.

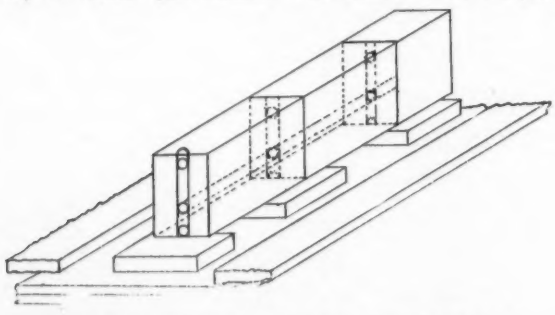
CRACKING AND FLOATING OUT

The cracking of blocks is as disastrous as their solution by the molten glass. If pieces of the blocks do not flow away, any horizontal portions of the cracks give access to penetration of glass with resultant upward eating.

Cracks can be avoided in most instances if tanks were brought up without rapid changes in temperature. However, under existing conditions rapid changes of temperature are, to say the least, rather common. Hence this problem is one for both the block manufacturer and the glass manufacturer to consider.

METAL LINE ATTACK

General observations indicate that in the case of tanks operated at relatively low temperatures, and without salt cake in the batch, blocks that serve well below the glass line also do well at the metal line. However, at the present time tanks are quite generally operated at high temperatures, and in the last three years the use of a small amount of salt cake for the purpose of scum prevention, has become quite common. The result of these changes is



SUGGESTION FOR A NEW TYPE OF BRIDGE

that at the metal line blocks are eaten away faster than the rest of the block.

It is not yet apparent exactly what percentage of this increased eating at the metal line is due to increased temperature. However, it is probable that, small as is the amount of salt cake used for scum prevention, the excess has a destructive action on the blocks at the metal line, which would be decreased if the amount of salt cake were lessened to absolute minimum requirements.

Lowering of the metal line, if the blocks are still in fair condition, will increase appreciably the life of the tank. Where tank failure regularly occurs at the metal line, it would be profitable to provide (in conjunction with glass feeders) for such a secondary line, during the construction of the tank.

FLOW HOLE ATTACK

The main action of glass flowing through a flow hole is to cut a channel vertically upward. From this fact it is evident that the life of a bridge is dependent on the amount of wear required for the glass to cut a channel up to the wind-line opening, and for upward eating from horizontal joints to do its work. From this it may be concluded that bridge service would be increased by increasing the vertical thickness of the blocks between the flow hole and the wind chamber, and by elimination of horizontal joints in the bridge.

BRIDGE CONSTRUCTION

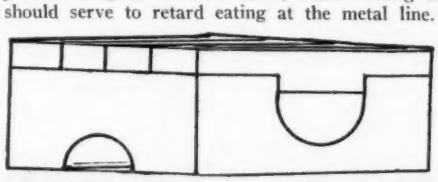
Many tanks fail through failure of the bridge or throat. The design of the bridge or throat can be improved in some ways, with resulting better service and longer life.

Glass men are not agreed on whether a bridge tank or throat tank is the better form. In the throat type, failures usually come only at or near the flow hole and may be held in check by water boxes or "overcoat blocks." In the bridge type tank, eating through may occur at any point across the width of the tank, but even after the lower part of the bridge wall has largely disappeared a water pipe through the air chamber may be maintained and glass frozen around it so as to act as a skimmer and the tank continued in operation for considerable time. When the water pipe finally does break, there is merely a disturbance within the tank without putting glass into the basement.

SPRAY COOLING

Spray cooling has certain advantages over the usual way of pumping water through iron containers. The latent heat of vaporization serves to maintain the chambers at suitable working temperatures. Since the cracking of tank blocks during "bringing up" of the tank is dependent upon the drop in temperature through the block, water cooling may be deferred until any desired time in the tank's life. To avoid thermal shock, due to the introduction of water, it should be preceded by steam for a suitable length of time. To minimize the trouble caused by "caking" of sediment in the pipes, steam may be introduced through pipes in the vertical channels, which can be periodically removed and renewed. Such a type of cooling is recommended by the great saving it would effect in cooling water.

Cooling of the lower horizontal passage way may serve to retard upward eating at the flow holes, while cooling the upper passage should serve to retard eating at the metal line.



DESIGN FOR A ONE-PIECE FLOW HOLE BLOCK

It has been common practice to use water in pipe lines through bridges after the latter have become old, and to place water boxes around throats of throat type tanks as they become old. The relatively large amount of cord and occasional batches of seeds

occurring in tanks thus maintained, suggest that glass congeals adjacent to the iron surfaces and that gobs of this partially congealed glass are occasionally pulled away by the stream of glass and swept out of the tank and into the ware. It would thus appear that it is preferable to have a block wall against rapidly moving glass, which is continuously swept clean, than a wall consisting of congealed glass.

Glass Flow

Glass men are not agreed as to the exact manner of travel of glass from the filling end of tanks to the bridge or throat. However, it would seem that the more numerous the flow holes, and the closer their tops are to the tank floor level, the more general or more nearly uniform, will be the movement of the glass. It might be expected that with the "multiple flow-hole" type of bridge with its "settling basin" effect on the melting side of the bridge, that stream formation would be more or less prevented. A similar form of "off take" on the refining side of a bridge insures a uniform distribution of glass into the refining end, across the width of the tank.

Art Design of Glass Ware

By Frederick H. Rhead, Zanesville, O.

The development of the glass industry in this country has reached the stage where the decorative and ornamental element are playing a more important part in the successful marketing of the products, and as a result organization activities are slowly but surely being adjusted to meet new requirements.

The present day art designer is usually more or less of an individualist, lacking in knowledge or experience in business fundamentals. The manufacturer himself, often without adequate practical resources, assumes the role of Art Director, a job which is difficult and hopeless because while he may be fully equipped to select and dictate, he possesses no organization for the creation and production of artistic wares.

Practically all designs submitted to manufacturers are made to consumers' specifications. The design is merely a sketch, showing the general appearance of the article. There are no accompanying sketches and data, showing the type of mold, manufacturing process, type of material, etc. Yet these must be provided before the article can be manufactured.

In order to demonstrate what is involved, a group of glass shapes were obtained through the courtesy of the Hazel-Atlas Glass Company. They were fairly representative of commercial production on a large scale. A commercial salt shaker was selected as a typical example. This is a small article, blown in a two, three, or four part mold, depending on the relief of the design. As a four and three part mold product is more expensive than wares made in two parts, it is obvious that in cheaper wares the factory specifications will require a design which can be made in two parts.

The designer will review similar products of other manufacturers weighing the success of these with the products of his own company. He will consider existing fashions and popular styles.

A designer permanently connected with a glass concern would have numerous sketches on file, with data, covering various articles. Under such conditions the manufacturer can find at once drawings of about everything needed in the development of his business.

There is a wide difference between the art engineer who designs for large scale production and those interested in small scale output only. The former may have strong personal preferences, but these must be subordinate to market requirements, without affecting the quality of his work. The latter can create and produce those things which satisfy his creative instincts.

The planning of an art glass course of training is an organization procedure, which should be worked out by a committee of broad-minded manufacturers, and technical men familiar with university instruction and plant procedure. Only under such conditions will a satisfactory course be planned, that will result in producing men who will supply the glass industry with this new type of engineer.

Large Clay Shapes for the Window Glass Industry

By Edwin P. Arthur, Vienna, W. Va.

Special clay shapes for the window glass industry, such as pots, rings and blocks must be made accurately to size and finished in a partially dry condition while "leather hard." Service requirements for the clay body are strict. The clay body for the shapes used in connection with the Lubbers, Colburn and Fourcault window glass machines must be of very uniform texture and the grog without impurities. Free silica should be present only in a very finely divided condition, if at all.

Many special clay shapes are necessary: Pots of the Lubbers system, pots and lip tile of the Colburn machine and the debiteuse blocks used in the Fourcault process. Anchor rings, ladle rings, floaters of special design, drawing bars and other shapes.

Drawn Window Glass

Most cylinder drawn glass is made with the Thornburg "double reversible pot." Nothing is more essential to the success of the Lubber cylinder system of window glass making than the drawing pot. When green an ordinary pot will be 41½ inches in diameter. It shrinks to 40 inches air dry and to 39¾ when burned. The inner surface of the clay drawing pots must be smooth. An angular corner where the pot wall meets the pot bottom without a substantial fillet will introduce air bubbles in the glass. A rough spot in the bottom will likewise cause bubbles. The surface of the pot is best left untouched with a dressing tool. It should have the smooth-water glazed surface or "skin" left on the body in drying, untouched from the so-called leather hard condition.

Flattening Stones

These are large slabs of clay, used in the flattening ovens, employed in the cylinder process for window glass. These stones may be as large as 60 x 84 inches and are about six inches thick. The surface receives much attention. It is scraped until as nearly plane as practical, the final polishing is given with a dressing of fine clay body with silicate of soda. In use they are often dusted with finely ground gypsum.

Colburn System Pots

Clay pots for the Colburn sheet glass drawing machine meet some of the same conditions that the pots of the cylinder system must withstand. However, they are not subject to alternate heating and cooling and the strains incident to ladling of glass, as well as the mechanical movements of the reversals. These pots are subject to uniform temperature conditions, except when the drawing machine is stopped or started, which is infrequent in the best practice. Mechanical stresses are constant and the pot is well supported in the heating kiln by clay stools. Exact dimensions of the Colburn pot are not so important.

Debiteuse Blocks of the Fourcault System

In the Fourcault system for the manufacture of sheet glass the glass is formed from the molten mass by extrusion through a slotted clay debiteuse block, held below the glass level in the tank furnace. It is subject to even stricter requirements than the clay pots of the other processes. They are formed by hand ramming into molds of the proper size. The slot is cut through the block after the shrinkage has taken place and the clay is in the "leather hard" condition. In this way warping of the block during drying is reduced to a minimum. The drawing block is subject to alternate heating and cooling. When a machine is started, the upper surface of the draw block is cooled to about 1,200 degrees F. in less than two hours. Steel shell water coolers rest on the top of the block near the sheet which is drawn from the slot. With the upper face of the block hardly dull red, the lower face is near 1,900 degrees F. and subject to constant flow of molten glass.

Clay body for shapes should be of dense uniform character, free from pits, pockets, lamination checks or cracks. The body itself must be of smooth uniform character. Irregularities cause objectionable defects in the finished sheet of glass.

Durox Glass House Refractories

By T. S. Curtis, Los Angeles, Cal.

Several years ago the Vitrefax Company became interested in what was at that time considered as sillimanite, which proved to be a remarkable refractory material. About a year was spent working on the theory, held in ceramic circles, that an alumina-silica ratio of 63 to 37 per cent was the proper kind. No progress was made until after the work of Bowen and Grieg of the Geophysical Laboratory was published, showing that the only stable compound between these two oxides consists of three molecules of alumina to two molecules of silica. This 3 to 2 ration is mullite.

Experience of making this material into brick showed that any appreciable amount of magnesia promoted a too great fluidity of the glassy material surrounding the crystals, and that lime had an even more harmful effect. Potash proved to be less harmful and in some cases even of some help.

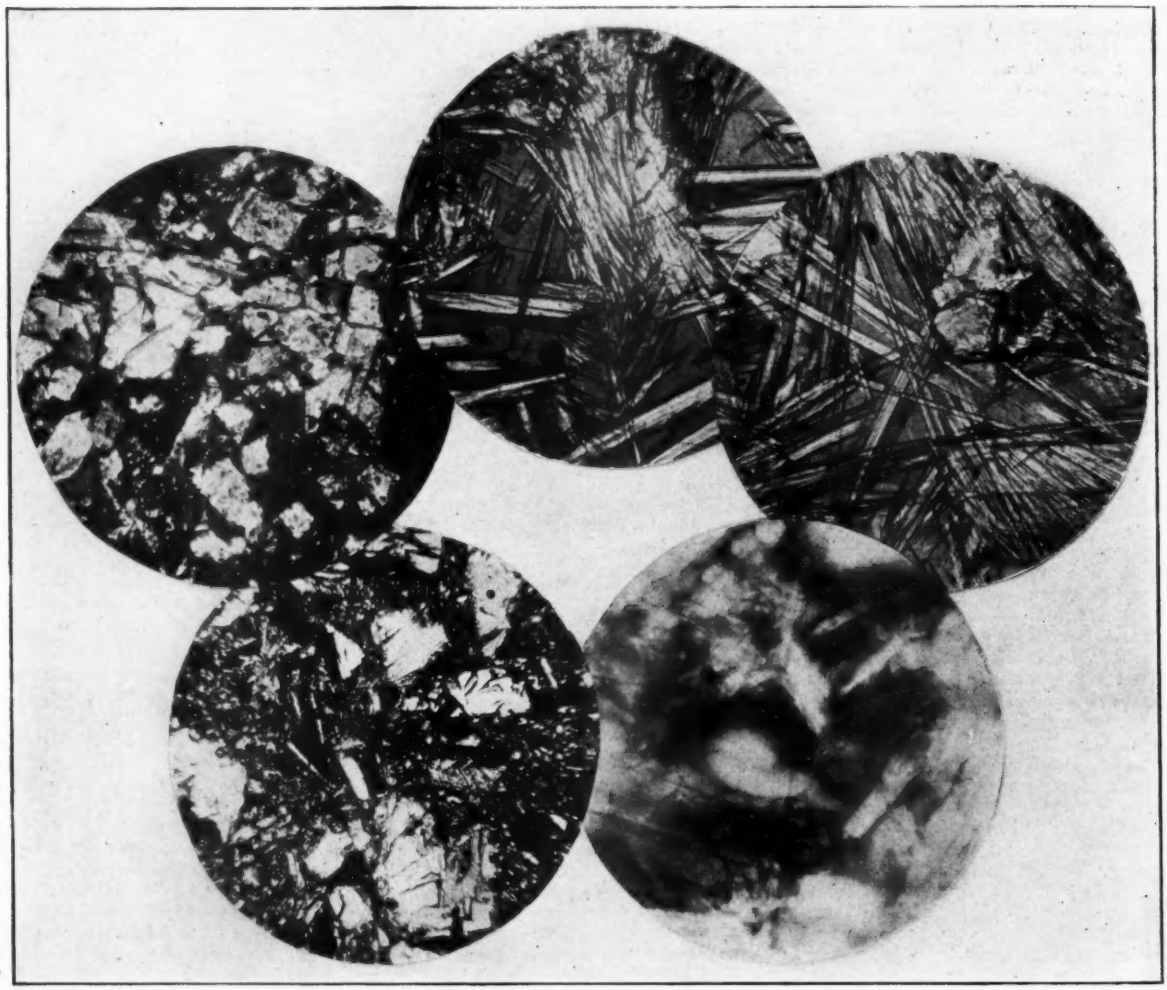
In the experimental work to use mullite as a glass house refractory material, it was shown that the slender, square shafted needles of mullite were nearly insoluble in every kind of glass that was tried. Investigation proved that carefully selected needles could be immersed in molten glass for hours without going into solution, provided they were of reasonably massive size when introduced. On the other hand it was found that crystals of alumina, in the form of corundum plates were rapidly attacked by glass.

Therefore the insolubility of the needles could not be ascribed solely to their alumina content. It meant that they represented a stable compound that was not easily broken up. To make a glass tank block that would outlast clay, there must be an aggregate mass of coarse crystals for the grog portion, and in between them must occur more crystals of the same composition, all thoroughly interwoven and interlocked.

For the purpose of investigating the secrets of mullite crystallization the petrographic microscope was used, which revealed that mullite crystallizes in a large number of forms.

The problem became then to develop methods of plant control to make possible the regular production of the right percentages of each size and kind and shape of crystals, found suitable for the production of refractory material, that is one in which the grog portion consists of great, strong, coarse fragments of mullite, interspersed with progressively smaller and smaller fragments of the same material. Finally the small remaining voids must be filled as full as possible with finely pulverized glassy material of the proper composition. In this material the right size and shape of slender mullite crystals and fragments of corundum must occur, so that when the whole mass is subjected to the correct heat treatment, during the proper length of time, a mass is obtained not unlike an asphalt pavement with grains of sand in it. The coarse grains serve to stiffen the mass so that it does not deform during firing, while the smaller crystals act as the grains of sand in the asphalt pavement, while the fine glassy material and corundum form a bond, holding the crystals together.

A large number of micro-photographs showing the composition and micro-structure of the blocks gave evidence of how the ideal composition of the blocks has been attained.



MULLITE CRYSTALLIZES IN A VARIETY OF FORMS

UPPER LEFT: Section through a grain of California Mullite showing massive or blocky type of crystal.

UPPER CENTER: Section through a grain of Ceramic Grade Durox showing curious entanglement of the slender crystals that occur in this product.

UPPER RIGHT: Another section of Ceramic Durox showing a corundum crystal enmeshed in the slender shafts of mullite.

LOWER LEFT: Section through a Durox Glass Tank Block, showing the remarkably massive form of the mullite crystals that constitute the aggregate or grog of this refractory.

LOWER RIGHT: A section of a zone between the massive mullite fragments shown in Fig. 4, illustrating the re-crystallization of the very fine grain used as a substitute for bond in the Durox Glass Tank Block. This photo-micrograph was made at 1500 diameters while the preceding pictures are at 150 diameters.

Resume Public Hearings on Cost of Plate Glass

Tariff Commission Releases Second Preliminary Statement of Information—Makes Comparison with Belgian Production Costs

PRIOR to the first public hearing, in November, 1925, on the cost of plate glass, the Preliminary Statement of the Tariff Commission giving the information available on the subject at that time was published in THE GLASS INDUSTRY, November, 1925, issue, pages 239 to 249. Readers who desire to refresh their memories on the testimony given at the first hearing are referred to the December, 1925, number and to the January and February, 1926, numbers.

In furtherance of its investigation into the cost of producing cast polished plate glass and having in view a possible revision of import duties on this commodity should it prove advisable or necessary to take such action, the United States Tariff Commission recently issued notice that a second public hearing on the subject would be given, beginning May 9, 1927, at the offices of the Commission in the Old Land Office Building, Eighth and E streets, N.W., Washington, D. C., at which parties interested may be present, produce evidence and be heard.

This is in continuation of the investigation begun by the Tariff Commission on May 5, 1923, to assist the President in the exercise of the power vested in him by Section 315 of Title III of the tariff act of 1922. The history of the Commission's activities in the matter up to the present time is given briefly in the Second Preliminary Statement, issued on March 25 and comprising over 70 typewritten pages of information obtained during the course of the investigation.

The statement suggests the problems given below, for discussion at the public hearing on May ninth.

Second Preliminary Tariff Statement Problems for Discussion

The attention of interested parties is particularly invited to the following problems concerning plate glass:

1. (a) What are the causes for the increased production and increased imports of plate glass?

2. Domestic and foreign cost data are submitted [in the Preliminary Statement] for the following periods:

United States, calendar years 1923, 1924, and 1925.

Belgium, calendar years, 1923, 1924, 1925 for two companies; fiscal years (ending June 30) for five companies for 1923 and for six companies for 1924 and 1925.

(a) Are 1923, 1924, and 1925 representative years for purposes of cost comparisons?

(b) What year or other cost period should be used as a basis of comparison?

3. Marketing and transportation.

(a) The statement of information shows marked differences in selling methods of foreign plate glass and of domestic plate glass. Do these differences in selling methods constitute an advantage or disadvantage in competition as contemplated by sub-section (c) of section 315, and how may such advantages or disadvantages, if any, be statistically determined?

(b) What use should be made of the transportation costs and incidental charges upon domestic and imported plate glass in connection with a cost comparison for the purposes of section 315?

(c) What is the principal wholesale market or markets for domestic and for imported plate glass in the United States?

(d) For what city or cities as the principal market should cost comparisons be made for purposes of section 315?

(e) With respect to the principal market or markets in the United States, is it desirable or permissible to consider regions rather than individual cities? If a region be taken on what principle should points within that region be chosen and by what method or methods should transportation rates to any given region be calculated?

(f) Should the comparison of domestic and foreign costs include selling expense?

4. Belgian costs in francs have been converted into United States currency by three methods:

(a) By method 1 the weighted average cost for each of the years 1923, 1924, and 1925, in terms of Belgian francs are converted at the average rate of exchange for the respective years. (See Table 18.)

(b) By method 2 the costs in francs for each specified year are converted at the average rate of exchange for that year and the six months preceding.

(c) By method 3 the weighted average costs in Belgian francs for the year 1925 are converted at the average value of the franc for the 3-year period 1923-24-25.

Which of these three methods is preferable for purposes of cost comparison? Suggestions as to any other suitable method are invited.

5. An average landing charge of ½ cent per square foot has been used for calculating delivered costs of imported plate glass. Is this a representative average for all ports of importations in the United States?

6. Has the development of the continuous process reached the stage where its cost of production may be deemed normal or representative?

7. Classification of plate glass for tariff purposes is presented. A discussion of this question is invited.

History of the Investigation

During 1923 and 1924 representatives of the Tariff Commission spent five months in the United States and Europe studying the costs of production of cast polished plate glass. Cost data were obtained from all producers in the United States; from one company in Belgium (owned largely by American capital), and from several companies in Germany. The Belgian plate glass manufacturers affiliated with the "Union Commerciale des Glaceries Belge" declined to give any information of a pertinent nature bearing upon costs of production. Belgium was at that time, and still is, the principal source of imports into the United States.

A preliminary statement of information with respect to the cost of production of cast polished plate glass was subsequently issued to interested parties, and a public hearing was held on November 23, 24, 30, and December 1, 1925. Representatives of the Belgian plate glass manufacturers and of plate glass importers at that public hearing, through counsel, requested the Tariff Commission to reopen the plate glass investigation in order that the commission might obtain more accurate and up-to-date data concerning cost of production, and that they might devote particular study to the developments which had taken place with respect to new processes of manufacture. At the same time the Belgian manufacturers assured the commission that opportunity would be afforded its representatives to obtain complete cost information from their records. The investigation was ordered continued by the commission, and the additional field work was undertaken in the summer of 1926. Cost of production and other data were obtained from all producers of polished plate glass in the United States and Belgium. These data have been summarized and are presented herewith.[1]

[1]Space limitations prevent the reproduction here of a number of tables contained in the Preliminary Statement.—EDITOR.

Rates of Duty

The act of 1922 (par. 222) fixed the rates of duty on imports of cast polished plate glass, finished or unfinished, unsilvered, as follows:

Not exceeding 384 square inches, 12½ cents per square foot.

Above 384 square inches and not exceeding 720 square inches, 15 cents.

Above 720 square inches, 17½ cents.

Uses of Polished Plate Glass

The principal use of polished plate glass at the present time is in the automobile industry, which alone consumes over 50 per cent of the current production. The next most important use is for window glazing. Increasing quantities are being used for this purpose in modern public buildings and in residences. Other uses are for mirrors, for deck and port lights on ships, for aquariums, and as a protective covering for desks and table tops.

Production, Organization, and Distribution

UNITED STATES

In 1925 there were sixteen plants, owned by six companies, producing polished plate glass in the United States, located as follows: Pennsylvania 8, Michigan 3, Illinois 2, Indiana 1, Missouri 1, Ohio 1.

Thirteen of the sixteen plants produced plate glass by the casting process; three used the so-called "new continuous process." The total production for all plants in 1925 amounted to 117,224,295 square feet—more than twice the production in 1921, and an increase of approximately 30 per cent over 1924. The production figures for 1924 and 1925, however, included a rather significant quantity of plate glass produced by the three plants using the continuous process, which were not operating prior to 1923. The output of plate glass in the United States in 1923 was 89,069,441 square feet; 1924, 91,554,474 square feet; 1925, 117,224,295 square feet; 1926, 128,857,875 square feet.

Five of the sixteen plants, owned and operated by one company, produce approximately 50 per cent of the total domestic output. Eight of the remaining eleven plants, controlled by automobile interests, produce approximately 35 per cent, the greater part of which is used by the controlling interests in the manufacture of automobiles and does not directly enter the competitive markets by general sales.

Over 90 per cent of the total 1925 sales of plate glass produced in the United States was sold in fourteen states. Approximately 45 per cent of this amount found an outlet in the state of Michigan alone,—mostly to supply the demand of the automobile manufacturers in Detroit and other automobile producing centers in that state.

The distribution by size of approximately 75 per cent of the total sales for 1925 is shown in Table 2.

TABLE 2.—SALES OF DOMESTIC POLISHED PLATE GLASS ACCORDING TO SIZE, 1925.

Size	Quantity Square Feet	Value		Percentage of	
		Total	Unit	Total Quantity	Total Value
Up to 384"	16,604,368	$5,415,935	$0.3262	19.21	11.72
384" to 720" ...	38,428,844	20,085,259	.5226	44.47	43.47
Above 720"	31,372,955	20,704,719	.6600	36.32	44.82
Total	86,406,167	46,194,909	.5346	100.00	100.00

EUROPE.

There were in Europe in 1926 thirty plate glass factories, located as follows: Germany 9, Belgium 8, France 7, Czechoslovakia 2, England 1, Italy 1, Spain 1, Holland 1.

The total production of these factories in 1926, as estimated by one of the leading authorities on the European plates glass industry, was approximately 106 million square feet, distributed as follows:

Country	Square feet
Belgium	37,660,000
Germany	26,900,000
France	15,064,000
England	15,064,000
Italy	3,766,000
Czecho-Slovakia	3,228,000
Holland	2,690,000
Spain	1,829,000
Total	106,201,000

It was estimated that the Convention group of factories would produce in 1926 approximately 86 million square feet, or over 80 per cent of the total European production.

The formation of this convention in 1904 is considered one of the outstanding events in the history of the European plate glass industry, and the relative importance of the industry today in Belgium, France, and Germany may be attributed largely to its activities.

The object in view in forming an international convention was threefold: first, to have a central office where statistics and other pertinent information could be collected and distributed to all member companies; second, to endeavor to bring about an equilibrium between the demand and supply of plate glass, and to increase and decrease productive operations proportionately as the demand fluctuated; third, to establish uniform prices at which plate glass should be sold in the world markets. The Convention neither buys nor sells the product of the member companies, nor does it assume any control over sales as long as established prices are adhered to. Neither does it interfere with member companies as regards their own organization, financial policies, methods of operation, etc.

The two principal committees of the Convention are: the "Comite Centrale" which establishes production quotas for all member companies, on the basis of their relative productive capacity, and the "Comite de Ventes" which fixes the general sales policy for all member companies. These committees are composd of representatives from the various groups of plate glass manufacturers in Europe who are affiliated with the Convention. A large amount of freedom of action is allowed by the Convention to the sub-groups which compose it, in order to foster harmony and cooperation, and no decision which affects the interest of a particular group is made without the consent of that group. In addition to those two committees which meet regularly, monthly and quarterly, there is a general meeting once or twice a year, which is attended by at least one representative from each member factory, and where general questions of interest to the industry as a whole are discussed.

BELGIUM.

The plate glass industry in Belgium, the principal source of imports into the United States, comprises eight companies, all in the southern part of the country in the valley of the Sambre River. These companies are:

Glaces Nationales, at Auvelais.

Glace d'Auvelais, at Auvelais.

Glaces de Moustier-sur-Sambre, at Moustier-sur-Sambre.

Glaces de Charleroi, at Charleroi.

Glaces de Floreffe, at Floreffe.

Glaces de Sainte-Marie d'Cignies, at Aiseau.

Glaces de Courcelles, at Courcelles.

Manufacture des Glaces et Produits Chimiques de Saint-Gobain, Chauny et Cirey; Franiere plant.

The total production of the Belgian companies in 1925 was approximately 35 million square feet, an amount estimated to be approximately one-third of the total European production, and less than one-third of the United States production for that year.

The growth of the Belgian plate glass industry is shown in Table 3.

TABLE 3.

Production of polished plate glass—Belgium 1851-1925.

Year	Square feet
1851[1]	815,000
1860[1]	860,000
1878[1]	2,205,000
1888[1]	7,747,000
1894[1]	11,836,000
1899[1]	17,431,000
1906[1]	26,900,000
1913[1]	25,800,000
1922[1]	33,700,000
1922-1923[2]	37,593,336
1923-1924[2]	42,748,839
1924-1925[2]	33,296,538

[1]Source: Glass Trade and Le Verre.
[2]Source: Belgian Plate Glass Manufacturers.

During the 1923-24 period all factories in Belgium were operating at their full productive capacity in order to meet the unusually large demand for plate glass at that time. During 1924-1925, how-

ever, production was reduced to about 80 per cent of estimated capacity. In 1926 some curtailment of production of plate glass in Belgium still continued, but the capacity for production remained the same as in 1923-24.

The first six of the eight Belgian companies of the foregoing list distribute their production through a single selling organization known as the "Union Comerciale des Glacories Belges." The Union organization buys the plate glass from the six Belgian companies referred to, and disposes of it in the different markets of the world at the best prices obtainable, and returns to each company the proceeds of sales less the selling expenses incurred by the Union and its foreign agents. Each company participating in this selling arrangement receives profits in direct relation to its sales to the Union. The Union itself makes no profit. The entire production of the six companies is, as a matter of fact, pooled and sold to the Union company for resale, and no part can be sold by any individual company acting independently.

All stock in the incorporated selling organization is owned by the six member producing companies. One share is held by each company and one share divided among five of the managers. The quality of the product sold is determined by a number of inspectors employed by the Union. All glass must have the inspector's stamp of approval, and the quality of each particular glass must be indicated by this stamp before it leaves the factory.

The money received by the Union from sales of glass is twice a month turned over to the six member companies, and furnishes a large part of their working capital. Prices of glass to all customers in any one country are the same, and must conform to the Union's wholesale price list, which usually quotes prices f.o.b. Antwerp, in the currency of the country to which the glass is exported.

Exports of plate glass by the Union to the United States and to all other countries for the years 1923, 1924, and 1925, are shown in Table 4.

The Glaces de Courcelles distributes its product through its own selling organization. Most of this company's plate glass is exported to countries other than the United States. The product of the French St. Gobain company's factory at Franiere, Belgium, is distributed through a selling organization, known as "Comptoir Francais D'Exportation de Glaces," with headquarters in Paris. This comptoir buys the plate glass from the St. Gobain company's factories in France, Belgium, and Holland, as well as from the other French companies, and sells it in the different markets of the world in a similar manner to that of the "Union" of Belgium.

TABLE 4.

Cast polished plate glass: Exports by the Belgian Union to the United States and to all other countries.*

Year	Exports to United States Square feet	Exports to All other countries Square feet	Relation of exports to United States to total exports Per cent	Value of exports to United States Total	Value of exports to United States Average per square foot
1923	12,173,722	21,651,285	36	$7,456,409	$0.612
1924	7,485,429	19,868,073	27	4,294,410	.574
1925	8,246,045	20,250,782	29	3,311,062	.401

*Based on information submitted by secretary of the Union Commerciale des Glaceries Belges.

United States Foreign Trade

IMPORTS.—For a number of years prior to the World War, total United States imports of polished plate glass from all countries were fairly constant at about 3 million square feet per year. During the war, however, when the production of plate glass was decidedly curtailed in the principal producing countries of Europe, imports practically ceased, and in 1919 amounted to only 4,173 square feet.

With the resumption of European production in the latter part of 1919 and in 1920, particularly in Belgium, imports began to increase, and in 1921 had again amounted to the pre-war yearly average of 3 million square feet, or approximately 5.5 per cent of the production in the United States for that year.

During the next two years, 1922 and 1923, there was an unprecedented demand for plate glass throughout the world. The great commercial expansion in the automobile and building industries, particularly in the United States, created such a demand for plate glass that domestic producers, although operating at capacity, were unable to meet orders. As a result, imports from Europe increased rapidly—from 3 million square feet in 1921 to over 10 million square feet in 1922, and to nearly 26 million square feet in 1923. Imports in 1923 represented an increase of almost 800 per cent over 1921 and were 29.1 per cent of the production in the United States for 1923.

Following this period of industrial activity, with its resultant effect on the demand for plate glass tin the United States, there was a general movemnt toward expansion throughout the domestic industry. A number of old plants were enlarged and several new ones were built in an effort to keep pace with the increasing demand. Expansion, however, was not confined to the United States alone, but was more or less general in all plate glass producing countries. The result was the creation of a supply of plate glass which, as evidenced by the decreased importation in 1924 and 1925, was greater than the increasing demand warranted. For each of these two years imports amounted to about 16 million square feet,—a decrease from the high level of 1923 of over 38 per cent. During 1926, however, there was a recovery in the volume of imports, bringing the total for the year to within 2 million square feet of the amount imported in 1923 or to 18.7 per cent of the production in the United States for 1926.

The production in the United States, imports and the relation of imports to the total production are shown for recent years in Table 5.

TABLE 5.

Polished plate glass, United States: Production imports, and the relation of imports to total production. (1923-1926)

Year	United States Production: Total[1] Square Feet	United States Production: Total Exclusive of That Produced by Automobile Interests for Their Own Use[2] Square Feet	Total Imports[3] Square Feet	Relation of of Imports to Total United States Production Per Cent
1923	89,069,441	74,600,565	25,918,562	29.1
1924	91,554,474	73,687,216	16,805,367	18.3
1925	117,224,295	91,691,333	15,845,883	13.5
1926	128,857,875	97,987,875[4]	24,044,969	18.7

[1]National Glass Budget.
[2]Domestic Manufacturers.
[3]Commerce and Navigation.
[4]Estimated on basis of 1925 production.

For a number of years Belgium has been the principal source of imports into the United States. Table 8 shows the relative importance of imports from Belgium as compared with those from other European plate-glass producing countries.

TABLE 8

Cast polished plate glass: Imports for consumption, percentage of total imports for specified years by principal producing countries.[1]

Year	Total Square Feet	Per Cent from—Belgium	Germany	England	Czechoslovakia	France	All Other Countries
1923	25,918,762	59.8	20.2	5.6	4.2	.8	9.4
1924	16,804,848	55.6	18.7	8.6	7.0	1.3	8.8
1925	15,845,883	55.0	14.7	15.0	5.4	3.6	6.3
1926	24,044,969	57.1	20.3	8.6	4.5	5.3	4.2

[1]Department of Commerce, Bureau of Foreign and Domestic Commerce.

An analysis of the 1925 imports from Belgium alone shows the larger part to have been of the ordinary glazing qualities one-fourth of an inch in thickness. The percentages of the different qualities as well as the different thicknesses imported in 1925 from Belgium are given in Table 8a.

TABLE 8A.

Cast polished plate glass: Imports from Belgium, percentages by quality and thickness.* 1925

Quality	Per Cent	Thickness	Per Cent
Ordinary glazing	82.30	1/8″	0.60
		5/32″	26.68
Mirror glazing	14.60	3/16″	7.39
		1/4″	63.89
Silvering	3.10	3/8″	.15
		1/2″	1.29
Total	100	Total	100

*Compiled from data obtained from the Brussels Consulate by agents of the commission.

EXPORTS.—Prior to the World War domestic exports of plate glass were insignificant, averaging in value less than $50,000 annually. During the war the United States became the principal source of the world's supply; exports in 1917 increased to 6,117,955 square feet, valued at $2,223,000, and in 1919 to 7,318,000 square feet, valued at $4,221,000. But from 1921 to 1926, inclusive, exports have declined steadily from 2,243,000 square feet, valued at $1,334,517, to 855,000 square feet, valued at $243,371. These post-war exports have been principally to South America, Japan, and Canada.

Prices

UNITED STATES.—Over 60 per cent of the sales of domestic plate glass in the United States is of "glazing" quality in sizes below 720 square inches. The price of plate glass of glazing quality, based on sizes from 384 to 720 square inches, advanced from 24 cents per square foot in 1913 to 85 cents per square foot in 1923—an increase of 254 per cent during the ten-year period. Since 1923 three reductions have been made in the manufacturers' prices of plate glass as of April, 1925, July, 1925, and January, 1927. The price of glazing quality, cut in sizes from 384 to 720 square inches was 85 cents per square foot in 1923 and 35 cents per square foot in March, 1927.

Table 12 compares Belgian export prices with the United States prices for the different cut sizes and stock sizes, and for all qualities.

inches, 12½ cents per square foot; above that, and not exceeding seven hundred and twenty square inches, 15 cents per square foot; all above that, 17½ cents per square foot. Plate glass described in this paragraph containing a wire netting within itself, not exceeding three hundred and eighty-four square inches, 15 cents per square foot; above that, and not exceeding seven hundred and twenty square inches, 17½ cents per square foot; all above that, 20 cents per square foot.

Subsequent to the period for which cost data were originally obtained, there has been developed in the United States a new process for manufacturing polished plate glass other than by casting. This is known as the "continuous" process, the product of which is to a degree in competition with the polished plate glass produced by the casting method.

The continuous process is entirely different from the method of production by casting, in which each operation is separate and distinct and in which more handling and transferring of the glass from one operation to another is required. The resultant product, although produced in a different manner than that of casting is, nevertheless, polished plate glass, according to expert testimony presented at the public hearing, and conforms with the definition of plate glass issued by the Bureau of Standards (Cir. No. 164, January 4, 1924), which reads as follows:

"II. DEFINITIONS OF THE GENERAL CLASS OF PLATE * * * * * *, AND ROLLED SHEET GLASS.

"Plate glass.—Transparent, flat, relatively thin glass having plane polished surfaces and showing no distortion of vision when viewing objects through it at any angle. Plate glass is made at present by casting and rolling large sheets periodically or *by rolling a continuous sheet*. The sheets are then ground and polished."

Although the product of the continuous process is considered polished plate glass by the trade, and when of equal quality is sold for the same price and used for the same purposes as cast polished plate glass, it is not *cast* polished plate glass. The commission has obtained information with respect to the cost of production of polished plate glass manufactured by the new process and also of the technical and competitive circumstances of this process for the years 1924 and 1925.

TABLE 12.

Cast polished plate glass: United States and Belgian wholesale prices, as of August, 1925, for all sizes and qualities.[1]

(Per square foot)

Area, Square Feet	Glazing, Stock Sizes [2] United States	Glazing, Stock Sizes [3] Belgium	Glazing, Cut Sizes [2] United States	Glazing, Cut Sizes [3] Belgium	Miror Glazing Cut Sizes [2] United States	Miror Glazing Cut Sizes [3] Belgium	Second Silvering Cut Sizes [2] United States	Second Silvering Cut Sizes [3] Belgium	First Silvering Cut Sizes [2] United States	First Silvering Cut Sizes [3] Belgium
1′ to 2′8″[4]	$0.18	$0.16	$0.20	$0.28	$0.25	$0.34	$0.29	$0.39	$0.35	$0.44
1′ to 2′8″[5]	.30		.42		.48		.53		.58	
2′8″ to 5′[6]	.40	.23	.50	.33	.65	.48	.70	.53	.79	.62
5′ to 7′	.46	.26	.53	.33	.73	.53	.80	.60	.89	.69
7′ to 10′	.50	.30	.55	.35	.78	.58	.85	.65	.95	.75
10′ to 15′	.52	.32	.56	.36	.82	.62	.92	.72	1.03	.83
15′ to 25′	.54	.34	.58	.38	.84	.64	.94	.74	1.05	.85
25′ to 50′	.56	.36	.62	.42	.88	.68	.99	.79	1.11	.91
50′ to 75′	.58	.38	.64	.44	.94	.74	1.05	.85	1.18	.98
75′ to 100′	.60	.40	.66	.46	.96	.76	1.08	.88	1.21	1.01
100′ to 120′	.64	.44	.72	.52						
120′ to 140′	.80	.60	.96	.76						
140′ to 160′	1.00	.80	1.18	.98						
160′ to 200′	1.15	.95	1.35	1.15						
200′ to 240′	1.40	1.20	1.65	1.45						

[1]Wholesale prices for both Belgian and domestic plate glass have been reduced since the above data approximately 15 per cent.
[2]F. o. b. plants. Packing charge additional averages 1 cent per square foot.
[3]F. o. b. Antwerp, Belgium Ocean freight, marine insurance and landing charges amount to 2½ cents per square foot. Duty, 1′ to 2′8″ (144 to 384 sq. in.) 12½ cents per square foot; 2′8″ to 5′ (384 to 720 sq. in.) 15 cents per square foot; above 5′ (720 sq. in.) 17½ cents per square foot.
[4]Applies to stock sheets 12/19 x 12/19 and to cut sizes not exceeding 18 inches in length.
[5]Applies to all stock sheets and cut sizes not included in [4].
[6]Sizes 10 x 40, 10 x 42 and 10 x 44 are billed at 1′ to 2′8″ prices.

Costs of Production

INTRODUCTION

The original order of the investigation, instituted by the Tariff Commission, covers commodities dutiable under Par. 222 of the tariff act of 1922. This paragraph, which deals exclusively with polished plate glass made by the casting process, provides:

Par. 222. Cast polished plate glass, finished or unfinished, and unsilvered, not exceeding three hundred and eighty-four square

It is impossible, without disclosure of confidential information to publish the specific cost data secured for the new process or the information respecting specific details of production. For the same reason also, it is impossible to make public a numerical statement showing differences in costs between the two processes since by calculations the costs for the companies operating the new process could be determined.

In view of the fact that considerable prominence was given to the new process during the discussion in the former public hearing of November 23, 24, 30, and December 1, 1925, and that one reason

for extending the original investigation of plate glass was based on the weight attached to alleged facts respecting it, a general indication of the nature of the information obtained with respect to the costs of the new process is presented below.

At the time of the former public hearing, the new process was announced in engineering journals as an event of a revolutionary character which was destined greatly to reduce the cost of plate glass.

With respect to the costs for the new process incurred during 1924 and 1925, as ascertained by the commission, it has been found that such costs are the costs of a technical undertaking which during that period was undergoing rapid change due to experimentation. The costs of change—of experimenting—are involved with the cost of producing the product sold and therefore these factors are so intermingled that it is questionable whether the cost data may be used. It is also questionable whether the factor of obsolescence in connection with the new process costs is determinable.

The investigation by the commission also shows that defects in plate glass produced by the new process, preceding inspection and final cutting are more numerous than those in plate glass produced by the older method at the same stage in manufacture. More cutting is therefore required and this results in the production of a larger amount of small and odd sizes. Consequently the average market value of the product of the new process is less than the average market value of the older process. Considering glass of equal quality, the ratio of sizes produced by the new process varies materially from that obtained by the old process.

The costs of production as ascertained by the commission for the new process plants are not included in the weighted average costs for the United States as shown in the general cost tabulations.

The new process costs as tentatively calculated by the Tariff Commission and subject to the limitations with respect to accuracy as indicated above do not change the weighted average cost for producing all plate glass in the United States to any important extent. The weighted average unit cost would be slightly increased in 1924 if the calculated costs for the continuous process were included in the average and the unit costs for 1925 would be slightly decreased by the inclusion of the new process costs. In either case the change upward or downward would not be far from one cent per square foot.

Costs of cast polished plate glass, for the United States and Belgium, are submitted herewith.

UNITED STATES

Cost of production data for the United States were obtained for ten plants for 1923, twelve plants for 1924, and thirteen plants for 1925. These plants produced practically the entire output of cast polished plate glass during the above-mentioned years.

The specific items of cost, taken from monthly and yearly cost sheets, as submitted by each company, were verified by the commission's agents by examination of the company's books and from these sources a total cost per square foot of plate glass was computed.

BELGIUM

Access to cost records and other sources of information made it possible for the commission to obtain complete detailed cost data for all companies manufacturing polished plate glass in Belgium for the period covered by the investigation. The weighted average costs as shown for Belgium in this statement represent the weighted average costs for the entire plate glass industry in that country that is, the costs for seven companies in 1923 and eight companies for each of the years 1924 and 1925. The costs for two companies for each of the years 1923, 1924, and 1925 are for calendar years; the costs for five companies for 1923, and six companies for 1924 and 1925, are for fiscal years ending June 30.

The same form of schedule as that used for determining United States costs was used for determining Belgium costs. The specific items of cost shown on this schedule were verified by the commission's agents by examination of the companies' books, and from these detailed items of cost and the amounts of production a total cost per square foot of plate glass for each company, and a weighted average for all companies were computed.

Belgian costs as secured for any cost ascertainment period of this investigation were costs expressed in paper francs and such costs must be converted into costs expressed in money of the United States before they can be compared with domestic costs. Furthermore, the value of the franc, as measured by current rates of exchange, was not fixed, but fluctuating. A problem arises, therefore, with respect to what value of the franc shall be taken for purposes of conversion. In Table 17, Belgian costs are shown in francs per square foot for each company producing plate glass. These costs in francs have been converted into American currency by three methods, described on the next page.

FROM TABLE 13.

Cast polished plate glass, United States Cost of Production by plants

Cents per square foot

Costs apply to all sizes, qualities, and to ordinary thicknesses.

Items	1925 Company A	B	C	D	E	F	G	H	I	J	K	L	M
Direct labor	7.06	11.26	14.98	7.74	8.00	11.09	7.16	16.33	13.90	10.80	10.51	10.36	11.35
Raw materials	4.19	5.19	6.01	4.42	4.67	5.63	4.09	4.52	5.38	5.04	4.45	3.33	3.83
Power and heat	6.10	5.59	13.06	6.06	7.66	9.36	8.34	8.15	7.13	7.43	7.06	9.53	6.61
Pots	1.59	2.09	2.16	2.01	2.06	2.15	1.90	2.37	2.84	3.17	2.30	1.19	1.49
Mfg. materials and supplies	4.81	4.91	7.25	5.50	7.71	7.76	4.50	6.93	5.83	7.94	6.92	4.95	4.43
Repairs and maintenance	2.59	3.12	3.54	3.15	2.97	1.36	2.95	1.96	1.34	4.72	2.75	2.91	1.97
Plant overhead	9.12	4.41	8.39	6.71	5.31	5.35	10.55	8.86	5.22	11.62	6.18	11.20	5.79
General office overhead	1.51	1.08	.46	1.47	1.09	.50	1.40	1.64	.45	1.38	2.18	1.26	.49
Total	36.98	37.65	55.85	37.06	39.38	43.20	40.89	51.26	42.09	52.10	42.25	44.73	35.96
Imputed interest at 6 per cent on fixed assets	2.58	2.54	2.73	1.98	1.73	3.09	1.93	4.08	10.70	3.74	5.17	2.07	3.02
Total including imputed interest	39.56	40.19	58.58	39.04	41.11	46.29	42.82	55.34	52.79	55.84	47.42	46.80	38.98

TABLE 14.

Cast polished plate glass, United States: Weighted average cost of production for specified years and period.

Items	Cents per square foot 1923	1924	1925	Average for 3-year Period
Direct labor	9.6173	9.9936	9.5757	9.6594
Raw material	5.0950	5.1330	4.5755	4.9193
Power and heat	8.9647	8.3990	7.2876	8.0492
Pots	1.9633	2.4436	2.0367	2.1468
Manufacturing material and supplies	6.4109	6.5217	5.9159	6.3440
Repairs and maintenance	3.1740	3.1515	2.8992	3.0627
Plant overhead	7.5670	9.8120	7.6841	8.3696
General office overhead	1.5200	1.5721	1.2772	1.4359
Total cost f.o.b. plant[1]	44.3852	47.0265	41.2519	43.9869
Imputed interest on net fixed assets at 6 per cent	2.2790	2.9711	2.9000	2.7316
Total cost f. o. b. plant including imputed interest	46.6142	49.9976	44.1519	46.7185
Selling expense	1.2510	1.3401	1.1188	1.2463
Total cost f. o. b. plant including imputed interest and selling expense	47.8652	51.3377	45.2707	47.9648
Number of plants	10	12	13	
Production (square feet)	83,897,416	84,896,501	104,256,286	

[1]Includes the following depreciation charge:

	Cents per square foot
1923	3.55387
1924	4.32985
1925	3.77127

By Method 1, the franc costs for each company for each of the years 1923, 1924, and 1925, whether fiscal or calendar, are converted at the average rate of exchange prevailing for the respective years. The annual average exchange rates were calculated from monthly averages of noon buying rates in New York for cable transfers of Belgian francs.

By Method 2, the costs in francs for each specified year are converted at the average rate of exchange for that year and the six months preceding. The franc costs for each twelve-month period, therefore, are converted at an average exchange rate extending over a period of eighteen months ending with the cost period.

By Method 3 costs in Belgian francs for the year 1925 only are converted at the average rate of exchange for 1923, 1924, and 1925; that is, at the average value of the franc for the whole three-year period of the cost investigation in Belgium.

Costs for	Conversion method No. 1	Conversion method No. 2	Conversion method No. 3
1923	100	110.6	
1924	100	106.0	
1925	100	97.3	105.3
Average 1923-25 inclusive	100	104.9	

FROM TABLE 17.

Cast polished plate glass: Belgium Cost of production, by plants Francs per square foot

Costs apply to all sizes, qualities, and to ordinary thicknesses

Items	1925 Company 1	2	3	4	5	6	7	8
Direct labor	1.214	.888	1.231	1.005	.876	1.255	.952	1.223
Raw materials	.426	.422	.456	.465	.408	.494	.439	.355
Power and heat	1.394	.911	1.312	.992	.853	1.056	.913	1.260
Pots	.293	.187	.306	.182	.215	.230	.281	.136
Mfg. materials & supplies	.919	.880	1.025	.764	.673	.826	.717	.706
Repairs and maintenance	.552	.516	.250	.571	.928	.562	.810	.449
Plant overhead	.522	.578	.642	.627	.494	.619	.384	.453
General office overhead	.681	.662	.191	.467	.422	.559	.668	.298
Total f. o. b. plants	6.007	5.044	5.368	5.073	4.869	5.601	5.164	4.880
Imputed interest at 6 per cent on fixed assets	.267	.205	.340	.291	.323	.184	.136	.239
Total including imputed interest	6.274	5.249	5.708	5.364	5.192	5.785	5.300	5.110

In Table 18 the franc costs are converted according to Method 1.

It is to be understood that the commission places these methods of conversion before interested parties for their consideration, without itself being committed to any particular choice between them, and for the purpose of drawing out suggestions of other possible methods.

The results of the application of each of the methods of conversion, as described above, are shown in various tables of this statement. In consulting the data of these tables it should not be overlooked that the effect of any particular method of conversion by itself, as embodied in weighted averages, is obscured by the weights employed in making such averages,—namely, the varying quantities of Belgian production for the different years of the investigation. Moreover, the user of these tables will not be able to prove or check the converted cost figures by applying to the costs in francs the rates of exchange shown in this statement, because to avoid disclosure of the costs of the two Belgian concerns keeping their costs on the calendar year basis ,the costs for both fiscal and calendar years have been combined in these tables.

The effect on costs in American currency of the rates of exchange used in converting Belgian costs for the various periods by the three methods of conversion is indicated below in a table of ratios.

ELEMENTS OF COST: UNITED STATES AND BELGIUM

1. LABOR.—This item includes all labor engaged in the processes of melting, casting, grinding, polishing, finishing, and packing plate glass. The cost of such labor as is required in the pot house, power and heat department, yard, mixing room and for repairs and maintenance is included elsewhere as a part of the cost for these various departments.

2. RAW MATERIALS.—This item includes the delivered cost at the plant of the ingredients of plate glass; melting sand, soda ash, saltcake, lime, arsenic, charcoal, and occasionally salt in some plants, and the cost of handling and mixing these ingredients.

3. POWER AND HEAT.—Power and heat costs include direct charges of coal used in the production of gas for the melting furnaces and annealing ovens, coal and briquettes for boilers and pot arches, natural gas (used in the United States only), electricity, labor, repairs and maintenance, and supplies. It also includes a share of the general office and plant overhead expenses prorated to power and heat on the basis of labor. Depreciation in Belgium is charged separately to power and heat. In the United States a general depreciation account is kept and that portion chargeable to power and heat is prorated on the basis of labor.

4. POTS.—This item of expense represents the total cost of the pots (clay crucibles in which the raw materials are melted) manufactured or purchased.

In Belgium, each company produces all the pots it requires in the plants in which they are used, whereas in the United States some companies purchase a part of their requirements.

TABLE 18.

Cast polished plate glass, Belgium: Weighted average costs of production in francs for specified years with conversion at the contemporaneous annual average rate of exchange, together with the average costs for three years.

Per square foot

Items	1923 Francs	cents	1924 Francs	cents	1925 Francs	cents	Average for 3-year period Francs	cents
Direct labor	.7442	4.486	.9186	4.241	1.0391	5.077	8.962	4.567
Raw materials	.4038	2.428	.5319	2.455	.4355	2.129	.4613	2.351
Power and heat	.8519	5.109	1.1114	5.131	1.0305	5.034	1.0018	5.095
Pots	.1536	0.931	.2034	0.939	.2281	1.116	.1942	.988
Manufacturing materials and supplies	.5491	3.268	.7668	3.541	.7986	3.900	.7040	3.556
Repairs and maintenance	.4629	2.778	.4773	2.204	.6189	3.028	.5140	2.635
Plant overhead	.2855	1.720	.4404	2.033	.5375	2.626	4176	2.104
General office overhead	.3560	2.116	.4870	2.250	.5001	2.442	.4477	2.261
Total cost f.o.b. plants[1]	3.8070	22.836	4.9368	22.794	5.1882	25.352	4.6368	23.557
Imputed interest at 6 per cent on fixed assets	.1374	0.838	.1934	0.893	.2484	1.215	.1910	.969
Total cost f.o.b. plants including imputed interest	3.9444	23.674	5.1302	23.687	5.4366	26.567	4.8278	24.526
Selling expense	.3191	1.674	.3476	1 663	.3539	1.685	.3399	1.587
Total cost f.o.b. plants including imputed interest and selling expense	4.2635	25.348	5.4778	25.350	5.7905	28.252	5.1677	26.113
Average rate of exchange for fiscal years; one franc=cents		6.36		4.61		4.92		
Average rate of exchange for calendar year; one franc=cents		5.22		4.64		4.76		

Costs in francs and cents are the combined costs of two companies upon the basis of calendar years, and of five companies for 1923 (six companies for 1924 and 1925) upon the basis of fiscal years ending June 30.

[1]Includes depreciation charges .183 1.117 .265 1.225 .341 1.667

When the pots are manufactured in the glass plants their costs consist of such direct charges as raw material (clay), labor, and repairs and maintenance, their costs also include a share of the general power and heat and plant overhead expenses. In Belgium a separate depreciation account is kept for pots; in the United States that portion of the general depreciation account chargeable to pots is prorated on the basis of labor.

5. MANUFACTURING MATERIALS AND SUPPLIES.—The grinding and polishing operations in the manufacture of plate glass require large quantities of grinding sand, plaster, emery, runner bars, rouge, and felt. Miscellaneous supplies used throughout the plant are also included in this item of expense.

6. REPAIRS AND MAINTENANCE.—These charges are for upkeep, including both labor and materials.

7. PLANT OVERHEAD.—Under this heading are depreciation charges (exclusive of those departmentally distributed), taxes, state and local for the United States; personal, corporation and license taxes for Belgium; workmen's compensation, fire insurance, salaries for plant superintendents, and miscellaneous plant expense.

8. GENERAL OFFICE OVERHEAD.—General office overhead includes office and officers' salaries and general office expense.

9. IMPUTED INTEREST.—The imputed interest charges for the United States and Belgium, were computed at the rate of 6 per cent on the average of the net depreciated assets for all companies at the beginning and end of each year for which costs were obtained.

The unit interest charge per square foot was obtained by dividing the total amount of interest for all companies by the total amount of square feet produced by those companies for each year.

The fixed assets and the depreciation reserve accounts for the Belgian plate glass companies as they appeared in the balance sheets of those companies could not be used, because,—

(1) The fixed assets accounts which showed the original costs of all properties (land, buildings, and equipment), acquired since the companies were organized, and the cumulative depreciation reserve account set up for these properties, were expressed in francs regardless of the value of the franc in terms of gold.

(2) The amounts set aside in their accounts for depreciation reserve were based on financial circumstances from year to year, rather than the amounts properly chargeable for depreciation.

The following method was employed to establish the value of the investment (net assets) and the amount of depreciation reserve for purposes of cost comparison.

The value in francs of the fixed assets minus the depreciation reserve at the beginning of the year 1914, when the franc was at par, was converted into United States money at par; and to the amount thus found was added for each subsequent year the amount of the

TABLE 22.

Cast polished plate glass, United States and Belgium: Comparison of the weighted average costs of production f. o. b. plants by specified years.

Per square foot

1925

Items	United States Cents	Belgium Francs	Belgium Cents[1]	Belgium Cents[2]	Belgium Cents[3]
Direct labor	9.576	1.0391	5.077	4.951	5.340
Raw materials	4.575	.4355	2.129	2.075	2.243
Power and heat	7.288	1.0305	5.034	4.911	5.287
Pots	2.037	.2281	1.116	1.087	1.175
Mfg. materials and supplies	5.916	.7985	3.900	3.805	4.094
Repairs and maintenance	2.899	.6189	3.028	2.948	3.221
Plant overhead	7.684	.5375	2.626	2.561	2.760
General office overhead	1.277	.5001	2.442	2.384	2.588
Total cost f.o.b. plants	41.252	5.1882	25.352	24.722	26.708
Imputed interest at 6 percent on fixed assets	2.900	.2484	1.215	1.184	1.276
Total cost f.o.b. plants including imputed interest	44.152	5.4366	26.567	25.906	27.984
Selling expense	1.120	.3539	1.685	1.693	1.717
Total costs f.o.b. plants including imputed interest and selling expense	45.272	5.7905	28.252	27.599	29.701

[1]Belgian costs in cents by method of conversion from francs employed in Table 18. (Method No. 1)
[2]Belgian costs in cents by method of conversion from francs employed in Method No. 2.
[3]Belgian costs in cents by method of conversion from francs employed in Method No. 3.

TABLE 24.

Cast polished plate glass, United States and Belgium. Comparison of weighted costs of production averaged for the three-year period 1923, 1924, and 1925.

Per square foot

Items	United States Cents	Belgium Cents[1]	Belgium Cents[2]	Excess United States Cost Over Belgian Costs: By Conversion Method Table 18	Excess United States Cost Over Belgian Costs: By Conversion Method Table 19
Direct labor	9.6594	4.567	4.783	5.092	4.876
Raw materials	4.9193	2.351	2.476	2.568	2.443
Power and heat	8.0492	5.095	5.356	2.954	2.693
Pots	2.1468	.988	1.033	1.159	1.114
Mfg. materials and supplies	6.3440	3.556	3.722	2.788	2.622
Repairs and maintenance	3.0267	2.635	2.757	.428	.306
Plant overhead	8.3696	2.104	2.191	6.266	6.179
General office overhead	1.4359	2.261	2.366	—.825	—.930[3]
Total cost f.o.b. plants	43.9869	23.557	24.684	20.430	19.303
Imputed interest at 6 per cent on fixed assets	2.7316	.969	1.062	1.763	1.670
Total cost f.o.b. plants including imputed interest	46.7185	24.526	25.746	22.193	20.973
Selling expense	1.2474	1.587	1.680	—.340	—.433
Total cost f.o.b. plants including imputed interest and selling expense	47.9659	26.113	27.426	21.853	20.540

[1]Belgian costs in cents by the metod of conversion from francs employed in Table 18. (Method No. 1).
[2]Belgian costs in cents by the method of conversion from francs employed in Table 19. (Method No. 2).
[3]Cost greater in Belgium.

TABLE 23.

Cast polished plate glass, United States and Belgium: Comparison of manufacturing costs each year by departments.

Per square foot

Department	1923 United States Cents	1923 United States Per Cent of Total	1923 Belgium Francs	1923 Belgium Per Cent of Total	1924 United States Cents	1924 United States Per Cent of Total	1924 Belgium Francs	1924 Belgium Per Cent of Total	1925 United States Cents	1925 United States Per Cent of Total	1925 Belgium Francs	1925 Belgium Per Cent of Total
Casting and furnace hall	18.438	41.59	1.7994	47.26	19.160	40.74	2.3482	47.56	17.344	42.07	2.2625	43.61
Grinding and polishing	20.284	45.75	1.2711	33.39	21.549	45.83	1.6235	32.89	18.508	44.88	1.8549	35.75
Wareroom	3.739	8.43	.3876	10.18	4.562	9.70	.5230	10.59	3.778	9.12	.5945	11.46
Packing and shipping	1.874	4.23	.3489	9.17	1.755	3.73	.4421	8.96	1.622	3.93	.4763	9.18
Total[1]	44.335	100	3.8070	100	47.026	100	4.9368	100	41.252	100	5.1882	100

[1]Does not include imputed interest charge or selling expense.
Belgium costs in francs are the combined costs of ~~two~~ companies upon the basis of calendar years, and of five companies for 1923 (~~six~~ companies for 1924 and 1925) ~~upon the basis of fiscal years~~ ending June 30.

increase, if any, of fixed assets less depreciation reserve, converted from paper francs to American money at the current rates of exchange. For each of the years 1923, 1924, and 1925 the amounts of depreciation calculated upon the units of property in Belgium were at the same rates of depreciation as were employed for the comparable units of property in the United States.

Table 25 shows the imputed interest charges for the United States and Belgium for the specified years.

a comparison of the amount of losses incurred in the manufacturing of cast polished plate glass in the United States and Belgium for the three operating periods specified.

Losses incurred in the manufacturing of plate glass may be due to several causes, such as: poor glass, breakage in process, either unavoidable or thorough careless handling, the elimination of defects in the polished glass; and the production of unmarketable sizes in the order cutting department.

TABLE 25.

Cast polished plate glass: United States and Belgium.[1] Comparison of imputed interest charges.

	1923		1924		1925	
	United States	Belgium	United States	Belgium	United States	Belgium
Net fixed assets	$33,304,385	$5,365,726	$42,048,516	$6,392,003	$50,391,114	$6,738,668
Amount of interest at 6 per cent	*1,912,360	321,944	2,522,911	383,520	3,023,467	404,320
Production (sq. ft.)	83,897,416	37,593,336	84,896,501	42,748,839	104,256,286	33,296,538
Interest per sq. ft.	$0.02279	$0.00856	$0.02971	$0.00893	$0.02900	$0.01215

*Includes imputed interest for one domestic company for eight months only.

[1]Total net fixed assets for all Belgian companies expressed in terms of francs were as follows: 1923, 107,538,144; 1924, 118,102,143 and 1925, 133,914,725.

These franc values were converted into dollars by method of conversion employed in Table 18. (Method No. 1).

TABLE 26.

Cast polished plate glass, United States and Belgium: Comparison by year of prices of principal raw materials, and of total batch

Per short ton

Ingredients of Batch	1923				1924				1925				
	United States	Belgium			United States	Belgium			United States	Belgium			
	Dollars	Francs	Dollars[1]	Dollars[2]	Dollars	Francs	Dollars[1]	Dollars[2]	Dollars	Francs	Dollars[1]	Dollars[2]	Dollars[3]
Sand	2.20	13.81	0.82	0.91	2.56	18.10	0.84	0.88	2.23	18.27	0.89	0.87	0.95
Soda	14.59	350.20	20.91	23.12	15.61	408.26	18.85	19.95	15.58	401.67	19.62	19.14	20.91
Saltcake	11.99	334.65	20.64	22.35	12.11	442.17	20.41	21.69	12.45	349.68	17.11	16.66	18.29
Lime	1.78	28.36	1.74	1.92	2.12	32.38	1.49	1.59	2.13	34.52	1.69	1.64	1.81
Batch	5.05	86.93	5.02	5.79	5.50	110.27	5.03	5.40	4.98	96.85	4.69	4.61	5.01

[1] Belgium prices in dollars by the method of conversion from francs employed in Table 18. (Method No. 1)
[2] Belgium prices in dollars by the method of conversion from francs employed in Table 19. (Method No. 2)
[3] Belgium prices in dollars by the method of conversion from francs employed in Table 20. (Method No. 3)

10. SELLING EXPENSE.—Selling expense covers direct and indirect expenses applicable to sales. For the United States this includes such items as commission to agents, salesmen's salaries and expense, advertising, bad debts, and a prorated share of plant and general office overhead. For Belgium the selling expense for the six companies affiliated with the Union selling organization, is divided into three parts: (1) the selling expense at the plant; (2) a prorated share of the general expense of the Union which includes salaries of officers and clerks, collection expense, depreciation, taxes, and general office expense; (3) a prorated share of the commission and traveling expense of the new York agent. The selling expense for the Franiere Belgian plant of the French St. Gobain Company, includes similar items to those for the six Belgian companies referred to above. The selling expense for the Glaces de Courcelles includes such expense as salaries for employes and miscellaneous expense directly chargeable to the sales department of this company.

PRICE COMPARISON OF RAW MATERIALS.—Table 26 gives the prices paid for the raw materials used in plate glass making in the United States and Belgium for the three periods for which data were obtained.

LABOR: In Belgium the labor rates are lower than they are in the United States.

It will be observed in Table 27 that the average daily wage paid Belgian workers in the plate glass industry is approximately one-fourth the average wage paid in the United States.

An arrangement has been in force for several years applying to all the plate glass factories in Belgium for adjustment of wages to increases in the cost of living, according to a sliding scale. This adjustment began with the index at 400 and an increase in wages of 5 per cent was given with every twenty-point rise in the index. After the index reached 490, a 5 per cent increase in wages was given for every 5 per cent increase in the index. No decreases are made until the index falls below 400. During 1926 a number of increases were made in an endeavor to meet the rise in living costs.

The relation of production to the number of employes for the industry in the United States and Belgium is shown for 1925 in Table 28.

LOSSES IN THE MANUFACTURE OF PLATE GLASS: Table 29 shows

TABLE 27.

Cast polished plate glass: United States and Belgium: Comparison of wage rates paid in the plate glass industry. (Wages per day of eight hours)

Occupation	1923		1924		1925		Average for 3 Years	
	United States	Belgium[1]	United States	Belgium[2]	United States	Belgium[3]	United States	Belgium[4]
Batch mixers	$4.54	$1.34	$4.50	$1.30	$5.11	$1.32	$4.72	$1.32
Furnacemen	4.48	1.70	4.80	1.64	5.28	1.65	4.85	1.66
Casters	5.08	1.50	5.58	1.49	5.40	1.51	5.35	1.50
Lehrmen	4.28	1.57	4.80	1.55	5.00	1.59	4.69	1.57
Layers	5.70	1.41	5.84	1.34	5.72	1.41	5.75	1.39
Cutters	5.24	1.47	5.60	1.40	5.50	1.45	5.45	1.44
Grinders	4.88	1.43	5.00	1.37	5.12	1.48	5.00	1.43
Polishers	4.80	1.42	4.72	1.37	5.20	1.43	4.91	1.41
Examiners	5.78	1.44	5.68	1.39	5.54	1.46	5.67	1.43
Packers	4.88	1.16	4.72	1.10	4.91	1.14	4.84	1.13
Gasmen	4.56	1.83	4.40	1.74	4.29	1.81	4.42	1.79
Pot makers	7.04	1.47	8.40	1.43	7.38	1.50	7.61	1.47
Bricklayers	7.36	1.40	7.20	1.34	7.57	1.37	7.38	1.37
Machinists	5.28	1.46	5.68	1.34	5.50	1.40	5.49	1.40

[1]Belgian francs converted into United States currency at the rate of one franc=6.36 cents (Average exchange rate for 1923).

[2]Belgian francs converted into United States currency at the rate of one franc=4.61 cents (Average exchange rate for 1924).

[3]Belgian francs converted into United States currency at the rate of one franc=4.92 cents (Average exchange rate for 1925).

[4]Simple average.

TABLE 28.

Cast polished plate glass, United States and Belgium: Production, number of employees and production per employee in the industry, 1925.

Country	Production Square feet	Number of employees	Production per employee Square feet
United States	104,256,286	10,750	9,698
Belgium	33,296,538	7,516	4,430

TABLE 29.

Cast polished plate glass, United States and Belgium. Comparisons of losses in manufacturing.

Items	1923		1924		1925	
	United States	Belgium	United States	Belgium	United States	Belgium
Rough glass to process sq. ft.	107,441,232	41,987,819	108,957,378	48,963,207	135,875,461	38,058,135
Marketable production sq. ft.	83,897,416	37,593,336	84,896,501	42,748,839	104,256,628	33,296,538
Loss in process and in order cutting sq. ft.	23,543,816	4,394,483	24,060,877	6,214,368	31,618,833	4,761,597
Percentage lost	21.91	10.47	22.08	12.69	23.27	12.51

TABLE 32.

Cast polished plate glass: Imports from Belgium, by ports of entry, and shipments from domestic plants to these ports and their vicinities for the year 1925.

Port of Entry	Belgian Plate Glass Entered at Specified Ports of Entry		Shipments from Domestic Plants to Specified Ports of Entry and Their Vicinities	
	Square Feet	Per Cent of Total	Square Feet	Per Cent of Total
New York	3,789,133	39.22	5,915,696	9.33
Detroit	1,485,551	15.37	25,678,521	40.49
Los Angeles	794,043	8.22	1,425,768	2.25
Chicago	663,704	6.87	5,644,005	8.90
Philadelphia	404,904	4.19	2,230,825	3.52
San Francisco	404,182	4.18	899,618	1.42
Norfolk, Va.	380,452	3.94	286,607	.45
Grand Rapids	341,540	3.53	1,565,987	2.47
Cleveland	278,714	2.88	3,007,748	4.74
Norwalk, Conn.	187,565	1.94	874,654	1.38
Seattle	168,319	1.74	403,620	.64
Baltimore	89,332	.92	417,014	.66
Boston	89,017	.92	1,902,870	3.00
Jacksonville, Fla.	87,633	.91	235,841	.37
Oakland, Calif.	74,076	.77	629,678	.99
Buffalo	65,963	.68	1,437,092	2.27
Toledo	64,731	.67	2,118,671	3.34
Tampa, Fla.	58,731	.61	227,680	.36
Portland, Ore.	45,478	.47	634,125	1.00
Richmond, Va.	39,850	.41	158,889	.25
Knoxville, Tenn.	24,101	.25	100,491	.16
Bridgeport, Conn.	20,570	.21	267,592	.42
Milwaukee	20,232	.21	1,071,582	1.69
Miami	19,164	.20	32,674	.05
Rochester, N. Y.	15,684	.16	298,717	.47
Washington, D. C.	10,948	.11	482,985	.76
Fall River, Mass.	10,195	.11	.....	..
Cincinnati	9,872	.10	2,314,537	3.65
Wilmington, Del.	7,281	.08	.....	..
Erie, Pa.	5,297	.06	946	..
Minneapolis	3,801	.04	1,015,546	1.60
St. Joseph, Mo.	891	.01	9,869	.02
Dayton, O.	633	.01	163,302	.26
Indianapolis	612	.01	1,962,605	3.09
Total	9,662,199	100.00	63,415,755	100.00

TABLE 34.

Cast polished plate glass: United States and Belgium. Transportation charges from domestic and Belgian plants to important centers of consumption in the United States.

1925.

Cents per square foot

To	Domestic Plants	From Belgian Plants [1]	[2]	[3]
New York	2.1700	2.8065	2.8095	2.8173
Detroit	1.6900	5.1805	5.1835	5.1913
Cleveland	1.5400	4.9605	4.9635	4.9713
Chicago	1.7800	5.8550	5.8580	5.8658
Pacific ports	6.7000	2.8065	2.8095	2.8173

[1]Belgian inland transportation costs in francs converted into cents by Method No. 1 employed in Table 18.

[2]Belgian inland transportation costs in francs converted into cents by Method No. 2.

[3]Belgian inland transportation costs in francs converted into cents by Method No. 3.

Transportation

Methods and Conditions of Marketing Belgian Plate Glass Exported to the United States

Of the eight Belgian companies producing plate glass, six sell their entire production, including exports to the United States, through a selling organization known as the "Union Commerciale des Glaceries Belges." Two other Belgian companies send plate glass to the United States, which is sold independently of the Union, but substantially in conformity with the sales practices of the Union.

The Union and the independent Belgian producers have sales agents in New York, and the Union has one in San Francisco. These agents work upon a commission basis, and out of the commissions pay their own expenses.

In addition to the agents of the Belgian companies there are a number of independent American importers who buy plate glass directly from Belgium. These importers are merchants who own the glass purchased, and some of them have their own warehouses for local distribution in the consuming centers of the United States. The price in Belgium which these independent importers pay for the glass conforms to the wholesale price of the Union quoted f.o.b. Antwerp.

Methods of Marketing Domestic Plate Glass

The large domestic producers of plate glass have warehouses located in the principal cities of the United States, and district sales agents are in charge of each local office and warehouse. These sales agents serve not only as representatives of the producing companies for selling plate glass in large quantities to jobbers, contractors, automobile and mirror manufacturers, but they also act as jobbing distributors. As jobbers they sell glass to the local dealers and small contractors in both cut sizes and stock sizes from supplies on hand at the warehouse. These jobbers' prices are usually from 15 to 20 per cent in advance of wholesale prices in large quantities. All sales by district agents, however, except the local jobbing sales, are billed directly from the factory to the consumer. The district agent obtains a commission on all sales of glass by his company in the district. A number of plate glass companies have more than one factory, but shipments of glass from these factories to the various areas of consumption in the United States are not always regulated by the economy of freight rates; operating conditions, demand in various territories, the character of the specifications, financial affiliations with consumers, and other considerations have an influence on the distribution of shipments from the various plants.

Transportation and Other Charges on Belgian Plate Glass to American Ports

Table 32 shows the shipments of Belgian plate glass during the year 1925 to the indicated ports of entry in the United States as compiled from customs invoices at the offices of the Consul General in Brussels. It also shows shipments for the same year from a number of representative domestic plants to or in the vicinity of the same cities listed as ports of entry.

In connection with this table attention is called to the fact that shipments of imported glass to the ports of importation are not necessarily consumed in or near such ports. For example, shipments from Belgium to New York, Philadelphia or Baltimore may be destined for points inland, including the important consuming centers of Detroit, Grand Rapids or Chicago.

Table 34 shows for the year 1925 the simple average freight rates on plate glass from all domestic plants to New York, Detroit, Cleveland, Chicago, and Pacific Coast ports, and the transportation and other charges from the Belgian plate glass plants to the same cities.

TABLE 36.

Cast polished plate glass, Belgium; cost delivered at important interior centers of consumption in the United States. The freight rate from the seaboard to the cities given is the simple average of the New York and Montreal (or Baltimore) rates

	1923		1924		1925			Average for 3-year period (1923, 1924, and 1925	
	[1]	[2]	[1]	[2]	[1]	[2]	[3]	[1]	[2]
Costs delivered at Atlantic Seaboard	26.1937	28.7331	26.3136	27.7491	29.0050	28.7125	30.7935	27.1705	28.4098
Transportation cost from Atlantic seaboard to Detroit	2.3740	2.3740	2.3740	2.3740	2.3740	2.3740	2.3740	2.3740	2.3740
Cost at seaboard plus transportation cost from seaboard to Detroit	28.5677	31.1071	28.6876	30.1231	31.3790	31.0865	33.1675	29.5445	30.7838
Costs delivered at Atlantic seaboard	26.1937	28.7331	26.3136	27.7491	29.0050	28.7125	30.7935	27.1705	28.4098
Transportation costs from Atlantic seaboard to Cleveland	2.1540	2.1540	2.1540	2.1540	2.1540	2.1540	2.1540	2.1540	2.1540
Cost at seaboard plus transportation cost from seaboard to Cleveland	28.3477	30.8871	28.4676	29.9031	31.1590	30.8665	32.9475	29.3425	30.5638
Costs delivered at Atlantic seaboard	26.1937	28.7331	26.3136	27.7491	29.0050	28.7125	30.7935	27.1705	28.4098
Transportation costs from Atlantic seaboard to Chicago	3.0485	3.0485	3.0485	3.0485	3.0485	3.0485	3.0485	3.0485	3.0485
Cost at seaboard plus transportation cost from seaboard to Chicago	29.2422	31.7816	29.3621	30.7976	32.0535	31.7610	33.8420	30.2190	31.4583
Costs delivered at Atlantic seaboard	26.1937	28.7331	26.3136	27.7491	29.0050	28.7125	30.7935	27.1705	28.4098
Transportation costs from Atlantic seaboard to Buffalo	1.7658	1.7658	1.7658	1.7658	1.7658	1.7658	1.7658	1.7658	1.7658
Cost at seaboard plus transportation cost from seaboard to Buffalo	27.9595	30.4989	28.0794	29.5149	30.7708	30.4783	32.5593	28.9363	30.1756
Costs delivered at Atlantic seaboard	26.1937	28.7331	26.3136	27.7491	29.0050	28.7125	30.7935	27.1705	28.4098
Transportation costs from Atlantic seaboard to St. Louis	3.5425	3.5425	3.5425	3.5425	3.5425	3.5425	3.5425	3.5425	3.5425
Cost at seaboard plus transportation cost from seaboard to St. Louis	29.7362	32.2756	29.8561	31.2916	32.5475	32.2550	34.3360	30.7130	31.9523
Costs delivered at Atlantic seaboard	26.1937	28.7331	26.3136	27.7491	29.0050	28.7125	30.7935	27.1705	28.4098
Transportation costs from Atlantic seaboard to High Point, North Carolina[4]	2.3580	2.3580	2.3580	2.3580	2.3580	2.3580	2.3580	2.3580	2.3580
Cost at seaboard plus transportation cost from seaboard to High Point, N. C.	28.5517	31.0911	28.6716	30.1071	31.3630	31.0705	33.1515	29.5285	30.7678

[1]Belgian inland transportation costs in cents by the method of conversion from francs employed in Table 18. Method No. 1.
[2]Belgian inland transportation costs in cents by the method of conversion from francs employed in Method No. 2.
[3]Belgian inland transportation costs in cents by the method of conversion from francs employed in Method No. 3.
[4]Freight rate from the port of Norfolk, Va.

Cost of Domestic and Foreign Plate Glass Delivered at Various Ports of Importation and Important Consuming Centers

For convenience of discussion, Table 36 shows the cost of Belgian plate glass delivered at various important consuming centers in the United States. Cost data f.o.b. the foreign plants are given in the cost Table 18. The average costs for the three-year period are also shown. In this column the cost data are weighted according to production by years, but the transportation and other charges are simple averages for each of the three years.

Table 37 shows the cost delivered from all of the domestic plate glass plants to the same cities for which Belgian delivered costs are shown. The weighted average factory costs from all domestic plants are given, to which is added the unweighted transportation rate from the plants to the cities named.

The delivered costs of both the imported and domestic plate glass to the cities shown in Tables 36 and 37 are to be considered as illustrative of the method of calculation, and do not commit the commission to the use of any particular city named as an equalizing point for foreign and domestic costs of production.

Classification of Polished Plate Glass for Tariff Purposes

In the course of the commission's investigation of *cast* polished plate glass, certain problems have arisen with respect to the classification of *polished* plate glass, because of the fact that since the enactment of the present tariff act, other processes than casting have been used both in the United States and in Europe in making polished plate glass.

In recent years imports have consisted in part of polished plate glass made by methods other than casting or rolling a continuous sheet. Such glass, known as cylinder and sheet glass, by virtue of having been ground and polished, is similar to and competitive with *cast* polished plate glass of like thickness and qualities. Cylinder and sheet glass polished is dutiable under paragraph 220 of the act of 1922 at lower rates than those applicable to cast polished plate glass.

Polished glass having the characteristics and uses of plate glass is now being produced by four processes, namely:

(a) By casting the metal from pots or crucibles on to a flat table, rolling it into sheets, and subsequently grinding and polishing the sheets thus formed, either on individual circular tables or by means of a series of continuous grinding and polishing machines. This is the principal method used in the production of polished plate glass in the United States and abroad. Fully 80 per cent of the world's production at the present time (1926) is by this method.

(b) By rolling continuous sheets of glass from molten glass which emerges from an opening in a continuous melting tank and subsequently grinding and polishing these sheets by means of continuous grinding and polishing machines. This method, known as the "continuous process" was introduced into the United States on a commercial scale in 1923. It is not used, however, in the principal plate-glass producing country of Europe.

(c) By grinding and polishing common window glass sheets produced by the blown cylinder process. Production by this method is at the present time limited to the hand-blown cylinder glass industry of Bavaria, Germany, and to a few small plants in Czechoslovakia.

(d) By grinding and polishing common window glass sheets produced by the several patented drawing machine processes, recently introduced into all European countries where these machines are in operation, namely, Czechoslovakia, Germany, Belgium, and France. Since 1924 this method has also been used to some extent in the United States.

The tariff act of 1922, as did prior acts, makes special provision for polished plate glass made by the casting process, but does not mention specifically polished plate glass made by any other method or process. Provision is made for polished glass in the following paragraphs of the act of 1922:

> Par. 220. Cylinder, crown, and sheet glass, by whatever process made, polished, not exceeding three hundred and eighty-four square inches, 4 cents per square foot; above that, and not exceeding seven hundred and twenty square inches, 6 cents per square foot; above that, and not exceeding one thousand four hundred and forty square inches, 12 cents per square foot; above that, 15 cents per square foot.
>
> Par. 221. Fluted, rolled, ribbed, or rough plate glass, or the same containing a wire netting within itself (not including crown, cylinder, or sheet glass), not exceeding three hundred and eighty-four square inches, three-fourths of 1 cent per square foot; all above that, 1½ cents per square foot; and all fluted, rolled, ribbed, or rough plate glass, weighing over 100 pounds per one hundred square

TABLE 37.

Cast polished plate glass, United States. Production costs f. o. b. plants,[1] transportation costs,[2] from plants to important centers of consumption and the cost of the two combined for specified years and for three year period.

Cents per square foot

	Place of Delivery	1923	1924	1925	Weighted Average for 3-year Period (1923-24-25)
(1) Production cost f.o.b. plants		46.6142	49.9976	44.1519	46.7185
(2) Transportation cost plants to	Boston	2.3400	2.3400	2.3400	2.3400
(3) Cost delivered [Sum of (1) and (2)].....	Boston	48.9542	52.3376	46.4919	49.0585
(2) Transportation cost plants to	New York	2.1700	2.1700	2.1700	2.1700
(3) Cost delivered [Sum of (1) and (2)].....	New York	48.7842	52.1676	46.3219	48.8885
(2) Transportation cost plants to	Philadelphia	2.1300	2.1300	2.1300	2.1300
(3) Cost delivered [Sum of (1) and (2)].....	Philadelphia	48.7442	52.1276	46.2819	48.8485
(2) Transportation cost plants to	Baltimore	2.1100	2.1100	2.1100	2.1100
(3) Cost delivered [Sum of (1) and (2)].....	Baltimore	48.7242	52.1076	46.2619	48.8285
(2) Transportation cost plants to	Norfolk, Va.	2.3700	2.3700	2.3700	2.3700
(3) Cost delivered [Sum of (1) and (2)].....	Norfolk, Va.	48.9842	52.3676	46.5219	49.0885
(2) Transportation cost plants to	Los Angeles	6.6800	6.6800	6.6800	6.6800
(3) Cost delivered [Sum of (1) and (2)].....	Los Angeles	53.2942	56.6776	50.8319	53.3985
(2) Transportation cost plants to	Seattle	6.7400	6.7400	6.7400	6.7400
(3) Cost delivered [Sum of (1) and (2)].....	Seattle	53.3542	56.7376	50.8919	53.4585
(2) Transportation cost plants to	Detroit	1.6900	1.6900	1.6900	1.6900
(3) Cost delivered [Sum of (1) and (2)].....	Detroit	48.3042	51.6876	45.8419	48.4015
(2) Transportation cost plants to....	Cleveland	1.5400	1.5400	1.5400	1.5400
(3) Cost delivered [Sum of (1) and (2)].....	Cleveland	48.1542	51.5376	45.6919	48.2585
(2) Transportation cost plants to.....	Chicago	1.7800	1.7800	1.7800	1.7800
(3) Cost delivered [Sum of (1) and (2)].....	Chicago	48.3942	51.7776	45.9319	48.4985
(2) Transportation cost plants to....	Buffalo	1.7900	1.7900	1.7900	1.7900
(3) Cost delivered [Sum of (1) and (2)].....	Buffalo	48.4042	51.7876	45.9419	48.5085
(2) Transportation cost plants to....	St. Louis	2.0900	2.0900	2.0900	2.0900
(3) Cost delivered [Sum of (1) and (2)].....	St. Louis	48.7042	52.0876	46.2419	48.8085
(2) Transportation cost plants to....	High Point, N. C.	4.1600	4.1600	4.1600	4.1600
(3) Cost delivered [Sum of (1) and (2)].....	High Point, N. C.	50.7742	54.1576	48.3119	50.8785

[1] Weighted average for 10 plants in 1923, 12 plants in 1924, and 13 plants in 1925.
[2] Unweighted average from all plants.

feet, shall pay an additional duty on the excess at the same rates herein imposed; *Provided*, That all of the above plate glass, when ground, smoothed, or otherwise obscured, shall be subject to the same rate of duty as cast polished plate glass unsilvered.

Par. 222. Cast polished plate glass, finished or unfinished, and unsilvered, not exceeding three hundred and eighty-four square inches, 12½ cents per square foot; above that, and not exceeding seven hundred and twenty square inches, 15 cents per square foot; all above that, 17½ cents per square foot. Plate glass described in this paragraph containing a wire netting within itself, not exceeding three hundred and eighty-four square inches, 15 cents per square foot; above that, and not exceeding seven hundred and twenty square inches, 17½ cents per square foot; all above that, 20 cents per square foot.

In the present tariff act, cylinder, crown, and sheet glass, unpolished, is ordinary window glass and is assessed for duty under paragraph 219, but when such glass is ground and polished, and its irregularities, blemishes, and other surface defects are thereby removed, it becomes polished glass and is used for the same purposes as cast polished plate glass, although it is classified as cylinder, crown, and sheet glass, polished, dutiable under paragraph 220.

According to the classification in the paragraphs cited above, a piece of *cast* polished glass, by designation plate glass, having a surface area not exceeding 384 square inches of whatever thickness, is dutiable at 12½ cents per square foot, whereas a piece of polished cylinder crown, or sheet glass of the same size and thickness, not designated plate glass is dutiable at 4 cents per square foot. There is no physical difference between the two pieces of glass, but the method of their production differs and it is the method that determines what rate of duty is applicable to the one and the other, through the joining of the word "plate" in paragraph 222. In the past, the prevailing idea with respect to plate glass seems to have been that it is not only polished but thick and that thick sheets of glass can be produced only by casting. Such was indeed the fact at the time when the tariff of 1922 was enacted, and even now it is true that polished plate glass over one inch thick can be made only from cast sheets, and that the thickness attainable through the other three processes is usually not more than ⅛ to ¼ of an inch.

The classification of polished plate glass for customs purposes may be dealt with upon at least four bases. *First*, with respect to the method of production of the sheets preceding the polishing; whether by casting, by rolling, by drawing, or by blowing into cylinders subsequently cut and flattened into sheets. *Second*, with respect to the superficial area or sizes of the polished plates; *third*, with respect to the thickness; and *fourth*, with respect to the quality, that is, the degree of freedom from defects which fits the glass for one use or another. Along with quality in this sense may be joined shape, in the sense of linear dimensions; pieces of glass of a certain width and length may be in great demand, while if they are of a slightly different width and length they are in small demand. Obviously still another basis of classification may be used, and that is value. This basis involves most of the above-mentioned factors, since value is directly dependent upon size, thickness, and quality.

Processes of Production of Plate Glass as Related to Classification

Inasmuch as polished plate glass of identical physical characteristics and uses (apart from exceptionally thick plate) is now made by a number of processes, it would appear that the designation "cast polished plate glass" is no longer significant for tariff purposes. Size, thickness, and quality (including shape), irrespective of the methods of production, are the major considerations.

Sizes of Plate Glass

The present tariff method of levying specific duties upon plate glass *graduated with respect to size* has been in use as far back as the tariff act of 1842. This legislative practice probably grew out of the fact, known to the Congress, that the smaller sizes were

regularly sold at a lower price per square foot than the larger sizes. This circumstance of variation in value, according to size arose in turn from conditions of production, namely that the small sizes were obtained by reason of unavoidable breakage and by cutting around defects in the large polished plates, which if they had been free from defects, would have been sold uncut at a higher price. In other words, manufacturers of plate glass could not control the production of the small sizes, associated necessarily with the production of the chiefly desired large sizes, and so adjust the amount of the small sizes to what the market would absorb at a higher and more satisfactory price. The conditions of production of small sizes of plate glass are on the whole the same now as formerly, but marketing conditions have changed. A certain class of small sizes, suitable for use in the automobile industry, is now in such demand that large and perfect plates, salable at a high value uncut, are deliberately cut to automobile sizes and shapes. The circumstance of the great and growing demand for automobile sizes of plate glass might justify a reconsideration of the structure of the graduated duties. Any such reconsideration should take into account the fact that there is another class of "small sizes," too small or not of the right shape to be used in automobiles, which manufacturers find difficult to market even at prices considerably lower than those obtained for all other sizes.

Thickness of Plate Glass

In general, plate glass made by the various processes, such as casting, continuous rolling, drawing in the form of sheets, and blowing in the form of cylinders, is competitive chiefly in the grades about one-eighth inch thick. Little polished plate glass one-quarter inch thick is made by any other process than casting or the continuous process in the United States. A considerable quantity of thick glass is made by the Fourcault process in Czechoslovakia, but it is not imported into the United States in polished form in large quantities. Inasmuch as the value per square foot of glass is in direct relation to its thickness, it would appear that some method of graduating the duty which takes thickness into consideration should be adopted.

Qualities of Glass

Variations in the prices of plate glass are due not only to difference in size and thickness but also to difference in quality. The silvering quality, for example, of a given size and thickness, may sell for as much as 80 per cent more than ordinary glazing quality of the same size and thickness.

Form of Duty

The foregoing discussion raises the question as to whether the duty on plate glass should take the form of an ad valorem rate, a flat specific rate per square foot, or a graduated specific rate per square foot.

A flat rate neglects the important element of the value or price of the various qualities and thicknesses. An ad valorem rate might be easier to administer than a graduated specific duty, and it would operate in relation with variations in value due to quality, thickness, and size of the plate, in so far as the market price for plate glass reflects consideration of these factors. From the standpoint of the domestic industry, however, the ad valorem rate has the disadvantage of being relatively low per unit of product when prices are low, and relatively high when prices are high.

If graduated specific rates of duty are to be retained, consideration should be given to the question as to whether they should be based on values of the product or on physical characteristics of the glass, such as size or thickness, or on a combination of such factors.

The Laboratory

Sulphur in Fuel, and Its Determination

Sulphur is an undesirable element in coal, and its determination is of considerable interest to the glass house chemist.

Sulphur is found in all coals, in amounts ranging from as low as 0.1 per cent to as high as 7 per cent. This element may occur in different forms:

1. The most common form in which sulphur in coal occurs is as iron pyrites, also called iron disulphide or marcasite. In some cases the pyrites is scattered in large masses or in partings, and may be readily recognized as such. In other cases it occurs in a very finely divided form, in particles too minute to be readily recognized.

2. As organic sulphur, where it is a constituent of organic compounds forming a part of the coal substance and in combination with the carbon compounds distilled off with the volatile matter when the coal is burned or heated. Some coals upon analysis show as much as two per cent of organic sulphur.

3. As calcium sulphate or as sulphate of iron; the latter form shows that coal has been exposed to weathering, and appears usually as a whitish-brown scale or coating on the coal surface.

4. Occasionally sulphur occurs in coal in the form of free sulphur, but the amount of such is usually quite small.

Heating Value of Sulphur

The unoxidized form of sulphur on combustion of the coal is burned to sulphur dioxide, liberating from 2,259 to 2,950 calories (4,050 to 5,300 British thermal units), the different values depending on whether it is present as organic sulphur or as pyrites. In the latter case, the heat of its combustion which results in the formation of sulphur dioxide and ferric oxide is about 700 calories (1,250 B. t. u.) higher than the combustion of sulphur in organic form to sulphur dioxide.

Relation of Sulphur to Clinkering of the Ash

The amount of sulphur has little or nothing to do with the clinkering tendency of coal. A study of ash-fusing temperatures as reported by the Bureau of Mines has shown that coals with as much as 3 per cent sulphur will have an ash-fusing temperature of 2,800° F. while ash of another coal with 0.6 per cent sulphur fuses at 2,100° F. and will clinker badly. However, the sulphur may be an indication as to the clinkering qualities of coal, if present as pyrites. It is the iron oxide, produced during combustion, which is responsible for the tendency to form clinkers. Oxide of iron itself produces no clinker, but other constituents of the ash of a silicious character, together with the iron oxide, fuse together at high temperatures, forming easily fusible silicates or clinkers.

When the sulphur in coal is present in the form of organic

sulphur, there is no relation between the amount present and the fusibility of the coal ash.

In gas making a low sulphur coal is required, as the gas from high sulphur coal will contain sulphur compounds, which may cause the clouding of glass. It is desirable to have not more than 1.50 per cent of sulphur present in coal, used for producer gas.

Determination of Sulphur in Coal

ESCHKA'S METHOD.[1] A considerable amount of experimental work has been done upon the determination of sulphur in coal. The majority of experimenters agree that Eschka's process is one of the most convenient methods and the American Committee on Coal Analysis has recommended the process for general use.

The method is based on the fact that when coal is heated with a mixture of magnesium oxide and sodium carbonate, and with an excess of air, all unoxidized sulphur is converted to sulphites and sulphates of soda and magnesia. When the burned mass is boiled with water, these compounds, and any sulphates already existing in the coal are dissolved out as alkaline salts. By adding bromine water to the solution, the sulphites are oxidized to sulphates, and the total sulphur can be estimated as $BaSO_4$, by precipitation with barium chloride solution.

PROCEDURE. One factor weight (1.374 grams) is transferred to a shallow porcelain or platinum dish of about 35 cc. capacity and 6½ cm. in diameter, containing about 1.5 grams of Eschka mixture (see below). The contents of the dish are thoroughly stirred with a glass rod, and 1.5 grams of Eschka mixture are sprinkled over the surface of the contents of the dish. The sample is placed in the front of a muffle furnace heated by gasoline gas or natural gas or better still, an electric furnace, heated to a dull red. The temperature is maintained there for twenty minutes, when it is exposed to about 800° C. until the carbon is consumed.

The dish is then removed from the furnace and cooled, the contents transferred directly to an 11 cm. filter paper, contained in a filtering funnel. The small particles adhering to the sides of the dish are moistened with water and transferred to the paper. The dish is washed with hot water, scrubbed with a policeman and the washings transferred to the paper. The paper and contents are washed to the complete removal of sulphuric acid. The filtrate, received in a 250 cc. beaker should now have a volume of approximately 150 cc. Ten cc. of bromine water and 5 cc. of hydrochloric acid are added and the solution heated to boiling. The sulphur is precipitated with 10 cc. of a ten per cent solution of barium chloride and allowed to settle in a warm place for at least an hour. The precipitate is filtered; the preliminary washing of the precipitate is done with hot water containing 1 cc. of hydrochloric acid per liter. The final washings are made with hot water alone and the washing is continued until the washings no longer react for chlorine when tested with silver nitrate. The paper and contents are then transferred to a platinum or porcelain crucible and a low heat is applied until the paper is entirely smoked off. The heat is then raised until the precipitate is completely ignited. The contents of the crucible are brushed upon a tared watch glass and weighed. The weight of the barium sulphate in grams, multiplied by 10 gives the sulphur content in per cent, which is reported in the second decimal place.

The filtrate should always be examined for barium sulphate, as traces will sometimes pass through the filter. It has been found that addition of a few drops of a concentrated solution of ammonium acetate just before transferring the bulk of the precipitate to the filter prevents the tendency of the precipitate to pass through the filter.

The Eschka mixture after leaching should be examined for sulphur by dissolving it in the least possible quantity of hydrochloric acid, filtering and treating the oxidized and slightly acidified filtrate with barium chloride solution.

A blank test should always be run on the reagents, in the same manner as the actual determination, and the necessary correction applied.

PREPARATION OF SODA-MAGNESIA MIXTURE (ESCHKA MIXTURE) Procure a "light" calcined magnesium oxide, which must be free from sulphur and water. If it contains moisture, ignite at a dull red heat in a covered platinum crucible. The heavy, dense oxide is not satisfactory. Mix two parts of the MgO with one part of pure Na_2CO_3, previously dried and ignited at a dull red heat. Grind the two together until thoroughly mixed and keep in a tightly stoppered bottle.

Sodium Peroxide Method

An accurate procedure, which is more rapid than the Eschka Method, is based upon fusing a sample of coal or coke with sodium peroxide. When certain precautions are observed this process is not dangerous to the operator, and results can be obtained in about 70 minutes after receipt of the sample by the chemist.

Exactly 0.7000 gram of the sample of coal is transferred to a nickel crucible containing 16 grams of sodium peroxide, and the contents of the crucible carefully mixed. In the case of coke or anthracite 0.7000 grams of the sample are mixed with 11.5 grams of sodium peroxide. The specified amounts should be used in order to obtain good results. The crucible should be provided with a cover having a small hole, through which an iron rod can be passed for the ignition of the mixture.

The crucible is supported on a triangle made of nickel-chromium wire, the three ends of which are bent downwardly, so that the crucible is about one inch from the table. The triangle is then transferred to a beaker, filled partly with water, so that the lower part of the crucible is immersed. The mixture in the crucible is fired by an iron rod, which is heated to redness, passed through the hole in the cover and removed as soon as ignition takes place.

When the crucible and contents have cooled, it is transferred to a beaker and the fusion dissolved in water. The liquid is slightly acidified with hydrochloric acid and filtered. The sulphur is determined by precipitation with barium chloride in the usual manner.

NOTE. If too little peroxide is used, the reaction will be violent. If too much is used, the combustion may be incomplete. It is important therefore to weigh out the correct proportions as stated.

[1] Zeitschrift für analytische Chemie, Vol. 13, 344.

Glass Industry

ESTABLISHED 1920

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A Great Invention

Less than a year ago, one of the largest electric light and power companies, in a letter to its stockholders, held up to ridicule the rustic from North Dakota, who asked an electrical engineer the supposedly foolish question: "When will Niagara Falls reach out here?"

Recent developments have shown that the joke is on the power company, and that the simple farmer had more confidence in the value of research than the publicity department of a mighty electric concern.

What may be the most important electrical invention of the year, in an age when great inventions occur almost daily, is embodied in Patent No. 1,617,007, granted to F. G. Baum, an authority on long-distance power transmission, who in 1922 drew up a plan for a national system of power distribution. The patents are assigned to the Westinghouse Electric and Manufacturing Company, and describe "a method that is more efficacious in imparting stability to long transmission lines than anything so far known."

We live in an age of wonders. There has never been a time in the world's history when new developments in industry occurred with such rapidity, one that has almost made us callous to the importance of some inventions, and makes us fail to realize the effect which they are going to have on our industries, and on our daily lives.

Heretofore, the longest distance which electricity could be transmitted economically over wires, and compare favorably with local power, was 250 miles. Transmission of profitable amounts of power over longer distances is prevented among other causes, by surges of the current, not unlike waves, occurring on a large surface of water.

According to statements by officials of the Westinghouse concern the capacity of a given high voltage transmission line can be increased 75 per cent at a cost not exceeding 20 per cent of the original cost of the line. The invention is said to eliminate one of the principal difficulties that have embarassed electrical engineers during the intensive super-power developments which have been taking place during the past few years.

The effect of this invention on the glass industry, which is becoming more and more dependent upon power, is obvious. It will make power available to glass factories, now isolated as regards the supply of electricity, or who have been prevented from installing electrical machinery due to the high cost of power. It will tend to discourage the building of generating stations by glass plants, and in many instances will save the outlay of capital needed for this purpose. It will make possible the development of the immense power resources of the Rocky Mountain range that will supply with cheap water power the industries of the Mississippi Valley. It will stabilize power rates over large areas. It will bring to reality the dream of electrical engineers who have seen the vision of generating power at the mouth of the coal mines, and its economical distribution from there, instead of hauling the coal from the mines, over mountain ranges to the power houses, located near the points of consumption.

Seventy-two per cent of the country's water power resources are located west of the Mississippi. Seventy-nine per cent of the demand for electricity is in the Eastern part of

the United States. With Niagara Falls in the North, Muscle Shoals in the South, the Rockies in the West and with the immense deposits of high grade coal of the Appalachian region in the center, the stage is set to make the valley of the Mississippi and its tributary streams the workshop of the world.

The cost of generating electricity is only about 20 per cent of the total bill. The other 80 per cent is the cost of delivering the service to the consumers' terminal. This cost however is being reduced by an army of workers in the research laboratories of such companies as the Westinghouse and the General Electric, who are incessantly adding to the store of knowledge concerning the generation and distribution of electrical power. It is research, which has reduced the cost of electricity to below pre-war levels, while most other prices have mounted over 50 per cent.

Engineers from all over the world are coming here to learn, if possible, the secret of our prosperity, and of our industrial accomplishments. They find that behind each worker is a greater amount of mechanical power than anywhere else. They find that in the main the secret of success lies in in the fact that hand labor is being eliminated and replaced by machines to a greater extent than anywhere else. The effect of this invention will further strengthen the position of American industry in the world.

Technical Consultation Service

Method to Determine Alkalies in Glass

QUESTION 106.—Please give a detailed description of the J. Lawrence Smith method of determining alkalies in glass, mentioned on the editorial page of your March issue.

ANSWER—Sodium oxide and potassium oxide in glass are determined by the J. Lawrence Smith method, named after its originator, an American scientist who published the method in the *American Journal of Science,* 2nd series, vol. 50, 1871, page 269. An excellent description can be found in Hillebrand's Analysis of Silicate and Carbonate Rocks, Bulletin 700, United States Geological Survey, obtainable from the Superintendent of Documents, Government Printing Office, Washington, D. C.

The method is based upon decomposition at a bright red heat of the glass by calcium oxide, with fused calcium chloride as a solvent. The calcium displaces the sodium and potassium, releasing them as soluble oxides and chlorides, which can be leached out of the mass, along with some lime and most of the calcium chloride formed. Calcium silicate, calcium aluminate, iron oxide, and magnesium oxide are left behind in insoluble form. The dissolved lime is removed with ammonium carbonate, all ammonium salts are driven off by heat and the alkalies are finally weighed as NaCl and KCl. The latter is changed to potassium platinic chloride, and the NaCl is obtained by difference.

The writer prefers to weigh the alkalies in the form of sulphates since there is less chance of volatilization during burning off of the ammonium salts.

The details of the procedure are as follows:

Mix a one gram sample of the finely powdered glass with 1½ grams of pure ammonium chloride in an agate mortar, and grind thoroughly until the mixture is reduced to an impalpable powder. Fine grinding is necessary for accurate results. Add 8 grams of pure calcium carbonate, and grind it with the rest until thoroughly mixed. Place one gram of calcium carbonate on the bottom of a platinum crucible, add the mixture from the mortar and cover with about two grams of calcium carbonate.

Place the crucible in a hole, cut in a sheet of asbestos, the hole of such size that about two-thirds of the crucible is below the sheet. Place a large porcelain crucible or a 50 cc beaker filled with water on top of the platinum lid. Heat the bottom of the crucible with a very small flame, (about one inch high) until the odor of ammonia is no longer detectable.[1] It is essential that the heating be done slowly, so that there is little or no loss by volatilization of the ammonium chloride, and calcium chloride is formed as completely as possible. About half an hour is required. Then slowly increase the size of the flame until the lower part of the crucible is brought to a red heat. Keep at this temperature for an hour. The mass in the crucible contracts in volume during ignition but fusion should be avoided.

Remove the burner, allow the crucible to cool, wash the under side of the platinum lid with a jet of water into a casserole, transfer the cake to the casserole, add water and heat until complete disintegration, which may be hastened by trituration with a pestle. Filter and wash with hot water. To the filtrate add a saturated solution of ammonium carbonate, filter, concentrate the filtrate to about 30 cc, add a few drops of ammonium carbonate solution, allow to stand for a few hours and filter into a small porcelain dish. Add 2 cc of sulphuric acid, 1:1, evaporate on a water bath, expel the ammonium sulphate and the excess of sulphuric acid by heating and add about 5 cc of water. Filter through a small filter into a tared platinum dish, evaporate to dryness and ignite over a small flame. Weigh as combined sulphates, $Na_2SO_4 + K_2SO_4$.

In glasses free from potash, the weight of the sodium sulphate multiplied with 43.64 gives the percentage of Na_2O present in the glass. If potash is present, it is determined as follows:

Dissolve the sulphates in water, add a few drops of hydrochloric acid and transfer the solution to a small porcelain dish. Add a small excess of platinic chloride solution[2], and evaporate to a pasty consistency in the absence of ammonia vapor. Add 80 per cent alcohol, rubbing the particles with a glass rod to separate the adhering masses. Decant the liquor through a tared Gooch crucible, wash with alcohol until the wash liquor is no longer colored with platinic chloride, then wash the precipitate on the asbestos filter with 80 per cent alcohol. Collect the filtrate and reserve for recovery of platinum.

Wash the precipitate thoroughly with ammonium chloride washing reagent to remove sodium sulphate, then wash with alcohol, dry at 105° C and weigh as K_2PtCl_6.

CALCULATIONS:

$$\text{gms } K_2PtCl_6 \times .3584 = \text{gms } K_2SO_4$$

$$\text{“ “ } \times .19376 = \text{ “ } K_2O$$

$$\frac{\text{gms } K_2PtCl_6 \times .19376 \times 100}{\text{weight of sample}} = \%\ K_2O$$

$$\frac{\text{gms total sulphates} - \text{gms } K_2SO_4 \times 100}{\text{weight of sample}} = \%\ Na_2SO_4$$

$$Na_2SO_4 \times .4364 = Na_2O$$

REAGENTS. Platinic Chloride Solution: Dissolve one gram of platinum in aqua regia and evaporate to a pasty mass. Add 5-10 cc of hydrochloric acid, evaporate as before and then add 5-10 cc of water. Repeat the alternate addition of hydrochloric acid and water with subsequent evaporation until all nitric acid and nitrogen oxides are completely removed. Finally take up the residue with a few drops of hydrochloric acid and water to make a volume of about 100 cc. The solution should be kept free from possible contamination by ammonia fumes.

Ammonium Chloride Washing Reagent: Dissolve 100 grams of ammonium chloride in 500 cc of water, add one gram of K_2PtCl_6 and shake at intervals of 6-8 hours. Allow the undissolved portion to settle overnight, filter and retain the undissolved K_2PtCl_6 for future use.

[1] Ammonia is formed by the following reaction: $2\ NH_4Cl + CaCO_3 = CaCl_2 + CO_2 + H_2O + 2NH_3$.

[2] It is not necessary to add enough H_2PtCl_6 to combine with *all* the sodium present, as the reagent combines first with the potassium to form K_2PtCl_6, which is insoluble in alcohol. It is therefore necessary to add only an excess of H_2PtCl_6 over that needed to combine with *all* the potassium.

Recent Patents

NEW INVENTIONS DESIGNED TO IMPROVE GLASS AND THE MEANS OF PRODUCING IT

Complete copies of U. S. Patent Specifications may be obtained from the Commissioner of Patents, Washington, D. C. Price 10c each

Changes in Patent Law and Procedure

Vital changes in patent law and procedure were made by legislation enacted in the recent Congress, effective April 1, 1927.

Public Law No. 580 amends R. S. 4900 and requires patent owners to mark their devices with the patent number instead of the patent date as heretofore. As to patent issued before April 1, 1927, it is sufficient to use the words "Patented...." together with the date of patent. Manufacturers reforming their patent markings might convert them to the use of the patent number.

Public Law No. 621 increases from five to six the membership of the Board of Examiners in Chief and increases the fee for obtaining a patent in cases where there are more than 20 claims.

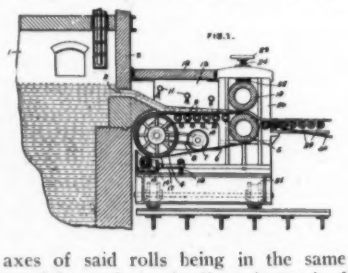
Public Law No. 662 changes the law with respect to suits for infringement of patents. It permits an appeal to the Circuit Court of Appeals before the order of accounting instead of afterwards, where the patent has been held valid.

Public Law No. 690 requires applicants to respond to an official action or take an appeal within six months instead of within a year as heretofore. A further provision clears up the law as to the paying of the fee when the last day for paying or taking any action falls on a Sunday or a legal holiday. It provides that the Patent Office may receive the document or the fee on the next succeeding business or secular day.

The new law cuts out the present procedure of appeals in the Patent Office and provides for a single appeal to a new Board of Appeals in the Patent Office, from which an applicant may appeal to the Court of Appeals of the District of Columbia, or may proceed by a Bill in Equity under Section 4915 R. S. But he can not do both as heretofore.

The right of appeal to the Circuit Court of Appeals is permitted in the same way as under former procedure.—*Washington Service Bulletin.*

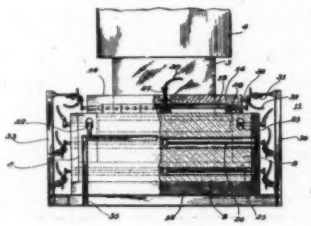
APPARATUS FOR MAKING SHEET GLASS. U. S. 1,615,840. Feb. 1, 1927. Halbert K. Hitchcock, Pittsburgh, Pa., assignor to Hitchcock Experiment Co. Filed 2/5/25. The combination with a glass tank having an outlet slot, of an endless belt of flexible sheet material with its upper flight in position to receive the glass from said slot, a roll over which the upper flight of the belt passes, and a sizing or dimensioning roll in opposition to said roll, the axes of said rolls being in the same plane lying at substantially a right angle to the line of travel of the glass.



GLASS-MELTING TANK. U. S. 1,615,832. Feb. 1, 1927. Frederick Gelstharp, Tarentum, Pa., assignor to Pittsburgh Plate Glass Co. Filed 8/18/23. In combination in a glass tank having a melting end and a withdrawing end provided with an outlet from which the glass is withdrawn or fed under the head pressure of the tank, of a cooling element in the form of pipe coils submerged in the glass at the withdrawing end, but spaced away from said outlet, and means for circulating a cooling fluid therethrough.

PROCESS AND APPARATUS FOR DRAWING SHEET GLASS. U. S. 1,615,841. Feb. 1, 1927. Harry F. Hitner, Pittsburgh, Pa., assignor to Pittsburgh Plate Glass Co. Filed 8/20/25. The combination with a melting tank, of a transverse drawing kiln, a connecting neck between the adjacent sides of the melting tank and the kiln below the level of the glass, electrodes at the opposite ends of the kiln, means for causing a flow of electric current between the electrodes throughout the major portion of the cross section of the kiln, and means for drawing a sheet upward.

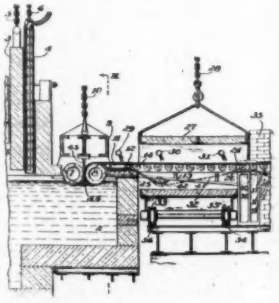
APPARATUS FOR MAKING SHEET GLASS. U. S. 1,615,842. Feb. 1, 1927. Harry F. Hitner, Pittsburgh, Pa., assignor to Pittsburgh Plate Glass Co. Filed 8/20/25. The combination with a glass melting tank having a drawing extension or kiln with a cover extending over the surface of the kiln and provided with a drawing opening, of means for drawing a glass sheet upward through said opening, and means for heating the glass comprising a resistance rod spaced above the glass in the kiln below said cover on each side of said drawing opening, and means for passing a current of electricity through said rods.



APPARATUS FOR SUPPLYING POLISHING MATERIAL TO A SERIES OF POLISHING MACHINES. U. S. 1,620,021. Mar. 8, 1927. Halbert K. Hitchcock, Pittsburgh, Pa., assignor to Pittsburgh Plate Glass Co. Filed 11/25/25. An improved arrangement for maintaining the rouge or other polishing powder always in suspension in the system including the conduits and fittings employed, so that clogging is prevented; an arrangement whereby the same character of mixture is supplied to all the machines and maintained constantly uniform; and an arrangement in which the polishing material is applied in such manner as to give a maximum speed of polishing combined with an economical use of polishing material.

APPARATUS FOR CUTTING GLASS. U. S. 1,618,089. Feb. 15, 1927. Harry F. Hitner, Pittsburgh, Pa., assignor to Pittsburgh Plate Glass Co. Filed 9/11/23. The combination with means for carrying forward a continuously formed horizontal ribbon of glass, of cutting off apparatus comprising a cutter frame above said means extending transversely thereof, cutter means mounted for movement longitudinally of the frame and having a motor for moving the cutter means along the frame, and means for raising and lowering the frame, so that during the cutting operation it may rest upon the glass and be carried along thereby.

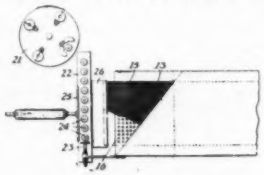
APPARATUS FOR MAKING PLATE GLASS. U. S. 1,615,834. Feb. 1. Frederick Gelstharp, Tarentum, Pa., assignor to Pittsburgh Plate Glass Co. Filed 5/18/26. A glass tank containing a body of molten glass, and having a slot in its upper wall, a pair of horizontal driven and cooled sizing rolls seated in said slot, and having the lower portions of their peripheries immersed in said body of glass, a bridge in which the ends of the rolls are journaled, triangular closure means for the spaces between the rolls at the ends thereof carried by the bridge, means for supporting the bridge for vertical movement, and a glass receiving bed extending laterally from the side of one of said rolls for carrying away the glass which is formed.



MANUFACTURE OF GLASS ARTICLES. U. S. 1,620,308. March 8, 1927. William Westbury, Canastoto, N. Y., and Patrick W. Collins, Elmira, N. Y. Filed 5/20/24. A new method which can be practiced advantageously in connection with the operation of the mechanism, shown in Serial No. 714,680, filed May 20, 1924. The method consists in supplying molten glass to a pot, drawing and severing the cylinder therefrom, then turning the pot into

inverted inclined position, reheating and draining the glass residue, and axially turning the pot during the reheating operation.

APPARATUS FOR HANDLING GLASSWARE. U. S. 1,618,660. Feb. 22, 1926. George E. Howard, Butler, Pa., assignor to Hartford-Empire Co. Filed 7/1/26.

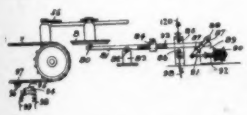


Apparatus comprising a lehr, a perforated lehr conveyor belt, and means for directing a current of air through said belt from a point beneath the same, to bring the ware to the desired temperature previous to subjection thereof to heat treatment within the lehr. Means for assembling rows of partially cooled ware, means for transferring the rows to the lehr, and means for subjecting the articles composing a row to varying degrees of temperature, to compensate for differences in temperature as between the various articles of a given row, the said means comprising a relative arrangement of lehr cover and assembling means such that the articles at the forward end of a row are brought under the influence of the heat within the lehr in advance of the articles further to the rear of said row.

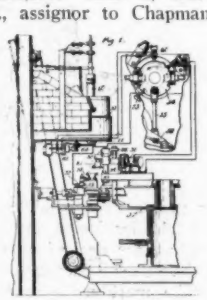
DRAWING FLAT SHEET GLASS. U. S. 1,614,110 Jan. 11, 1927. Enoch T. Ferngren, Toledo, O. Assignor to Libbey-Owens Sheet Glass Co. Filed October 4, 1923. In the art of drawing sheet glass the process of reheating a sheet of glass, consisting in applying a series of flames to the sheet surface, and oscillating these flames to equalize the distribution of heat.

GLASS-POLISHING APPARATUS. U. S. 1,610,658. Dec. 14, 1926. Charles H. Christie, Butler, Pa. Filed 5/22/25. Glass polishing structure comprising an annular block, a ring-like member adapted to loosely surround said block, a polishing pad, means for securing pad to member, comprising a band disposed concentrically of said member and serving to clamp the pad against the same, and means for detachably securing member to the block.

REGULATION OF GLASS FEEDERS. U. S. 1,619,729. Mar. 1, 1927. George E. Howard, Butler, Pa. Filed 6/9/23. To provide a method of keeping constant, within predetermined limits, the weight of the mold charges delivered by a glass feeder, by periodically weighing one of the bottles or other glass articles produced from the mold charges, and causing the weight of the periodically selected articles to automatically increase or decrease the rate at which the molten glass is delivered by the feeder if such articles are substantially below or above the normal limits of weight and to accomplish this without disturbing the normal progress of the ware from the machine to the annealing lehr.



GLASS-WORKING MACHINE. U. S. 1,620,292. Mar. 8, 1927. Alexander Samuelson, Terre Haute, Ind., assignor to Chapman J. Root, Terre Haute, Ind. Filed 7/27/22.

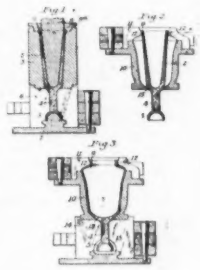


The combination of a vertical support, a blow-head-support pivoted on said support and vertically movable thereon, a blow-head carried by said blow-head support, a cylinder-and-piston unit connected to said blow-head-support, to produce vertical movement thereof, a cylinder-and-piston unit connected to said blow-head-support to produce swinging movement thereof, supply pipes leading to said two cylinder-and-piston units, means for controlling flow of motive fluid therethrough, and intermediate connections between the two cylinders and controlled by the relative movement of their pistons whereby successive lateral and vertical movements of the blow-head are obtained.

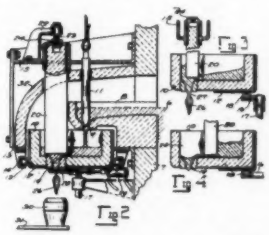
APPARATUS FOR FORMING GLASS SHEETS OR PLATES. U. S. 1,617,653. Feb. 15, 1927. George A. Shields, Columbus, O. Filed 6/11/25. In a device of the character described, a main tank, a working out chamber communicating with said tank, means for withdrawing glass from said chamber to form sheets, and an annealing chamber formed adjacent said main tank and adapted to be heated by radiation therefrom.

GLASS-CUTTING MACHINE. U. S. 16,550 Reissue. Feb. 15, 1927. John A. Milliken, Ambler, Pa., assignor to John E. Marsden, Atlantic City, N. J. Filed 8/21/16. In a glass cutting mechanism of the character described comprising a chuck, a grinder, means for alternately moving the grinder into and out of engagement with an article to be operated upon, and a feeler member reciprocated to and from said article by corresponding movements of said grinder.

MAKING BLOWN-GLASS ARTICLES. U. S. 1,618,747. Feb. 22, 1927. Edward E. Bartlett, Sapulpa, Okla. Filed 3/4/26. The invention provides for placing a blank in a one-piece mold having an opening of sufficient size to permit passage of the appended portion of the article therethrough, blowing the article in the mold, and withdrawing the blown article from the mold, the appended portion being withdrawn through such opening. Preferably, the opening is substantially closed off for the blowing operation, as by using a two-part mold or mold closure. This does not materially affect the quality of the product and it simplifies the blowing operation.



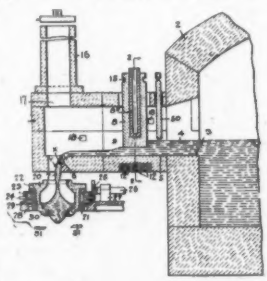
DELIVERING CHARGES OF MOLTEN GLASS. U. S. 1,618,290 Feb. 22, 1927. Richard La France, Toledo, O., assignor to the Owens Bottle Co. Filed 8/11/20.



A receptacle to contain molten glass, having an outlet opening in the bottom thereof, a regulator projecting into the glass in the receptacle, and means to cause a relative horizontal reciprocating movement of the receptacle and regulator by which the regulator is moved toward and from said outlet, said receptacle and regulator being so shaped that the glass is piled up over the outlet in advance of the regulator, whereby the flow of glass through the outlet is accelerated, said regulator being operable as it recedes to exert an upward pull or retarding action on the glass in said orifice.

METHOD OF AND APPARATUS FOR SHAPING MOLTEN GLASS. U. S. 1,617,220. Feb. 8, 1927. Karl E. Peiler, West Hartford, Conn., assignor to Hartford-Empire Co. Filed 3/30/22. Apparatus for shaping a glass parison, comprising a mold having an imperforate pocket, and means for creating a partial vacuum.

METHOD AND APPARATUS FOR FEEDING MOLTEN GLASS. U. S. 1,620,207. Mar. 8, 1927. George E. Howard, Butler, Pa., assignor by mesne assignments, to Hartford-Empire Co. Filed 2/20/22.



The method of producing mold charges of molten glass that comprises receiving a descending stream of glass in a heated receptacle having a discharge opening in its bottom, rotating the said receptacle to accumulate a mass of glass therein by centrifugal force, partially reducing the speed of said receptacle, thereby permitting glass to flow through said opening by gravity, retarded by centrifugal force, then stopping the rotation of said receptacle, thereby permitting glass to flow through said opening by unchecked gravity while leaving a portion of said glass adhering to the hot walls of said receptacle, then increasing the speed of rotation of said receptacle to produce an attenuation in the glass beneath the said opening, and severing the glass at the point of attenuation.

Glass Factory Equipment and Supplies

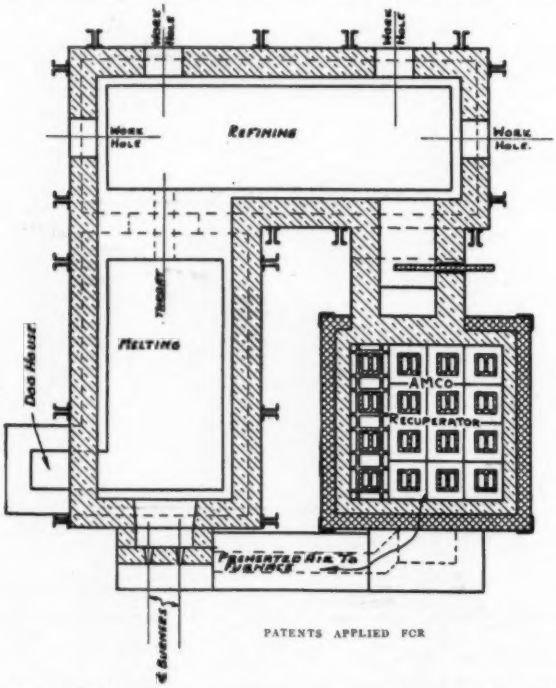
Most of the information printed in this department comes direct from the manufacturers of the products described.

A New Glass Melting Tank

A melting tank of new design has been developed by the Amsler-Morton Company, Pittsburgh, Pa. It is designated the "L" tank and is reported to be in successful operation producing a remarkable quality of flint glass from a relatively small hearth of shallow depth.

The "L" tank varies from the ordinary tank in form only. A rectangular refiner of relatively greater area than the melting end is used to facilitate removal of the glass by hand. Combustion is completed within the confines of the melting end and the waste gases are passed through the refining end, by two ducts, one in contact with the glass, the other isolated therefrom for the purpose of controlling the glass working temperatures with more accuracy than the prevailing types of furnaces.

A distinctive feature of this furnace, is the flow of the incandescent gases of combustion as a "blanket" covering the entire surface of the metal to be combined in the process, thereby imparting a uniform heat to all of the glass surface exposed to such action, eliminating convectional action within the glass due



to "streaky" heating as in the present types of tanks. A reduction of this action immediately before the bridge wall results in less seed being carried into the refiner with the melted strata of glass. This furnace seems to be particularly free from this trouble, when operating at higher ratings per unit of hearth area than most conventional type tanks; in spite of the fact that the metal depth is about half the usual.

The design of the tank is such that combustion is continuous in one direction toward the refining end, the products of combustion all passing to a recuperator through the refining compartment. The use of the recuperator eliminates reversing valves, labor and attention and permits the use of an ideal flame condition. The recuperator is situated in the angle formed by the melting end and refiner, making a very compact arrangement with a minimum of flues to liberate costly fuel in the form of radiation.

Present operations indicate a melting rate of a ton of pot quality glass when continuously operated for 24 hours on less than 6 square feet of hearth.

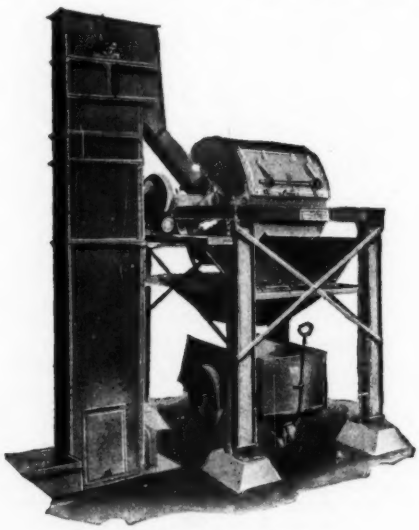
The investment phase involved is very interesting. A small tank requires a small initial outlay for a given tonnage. More than double the quantity of glass per ton produced is required in the ordinary tank than in the "L," another feature for the small pocketbook.

The "L" tank is built entirely above the factory working floor for hand or machine operation; although, a natural draft recuperator is preferred with its equality of pressures. Such an installation requires a heat exchanger situated well below the floor level, if sufficient hydrostatic pressures required to impress the required port velocities are to be imparted without artificial means. Complete release of the energy over the bath in the melting end cannot prevail with low port or fuel mixing velocities. These velocities are well defined from furnaces now in operation in the industry, but are slightly increased in the "L" tank to increase the rate of air and fuel mixing, thereby improving the pick-up of the furnace and raising the temperature range, in combination of course with economical preheat temperatures.

The Simpson Batch Mixer

A mixer for glass batch that has been in operation over a considerable period in various factories, and demonstrated its ability to satisfactorily meet their requirements at an economical installation cost and operating expense is the Simpson machine, here illustrated. It is manufactured by the Simpson Foundry & Engineering Company, Newark, O.

In operation, the batch materials enter the mixer through the end of the drum, made of ¼-inch steel plates, which rotates continuously, and the mixed batch is discharged intermittently



SIMPSON BATCH MIXER

by means of a hand lever. A thorough mixture is obtained by fixed baffles inside the drum, so designed and constructed as to produce the desired effect on the batch as the drum revolves. In a little over a minute a batch is made ready for use.

The machine is made in five standard sizes with capacities, ranging from 1,000 lb. to 3,000 lb. batches, and may be either motor or belt driven.

The complete installation can be designed with the mixer either above or below the batch room floor line as desired, and fed from a bucket elevator or by other suitable means. The discharge of the batch is into wheelbarrows or onto a conveyor.

A folder giving dimensions and capacities of the different sizes of machines is available on request to the manufacturer.

The Glass World and What It Is Doing

News of the Industry

Some Electric Bulb History

In the course of a talk recently given to about 200 of the business and professional men of Corning, N. Y., by President Alexander Falck of the Corning Glass Works, some interesting facts concerning the company's operations and policies were disclosed. Mr. Falck described the progress of the plant and said that when confronted with the necessity of "evolving from hand glass making to the modern plan which had to be adopted, Corning Glass Works sought to keep a foremost position, not abreast."

Taking the months of January and February, in 1907, Mr. Falck showed that the average payroll of the glass works was $46,029.13 per month while 10 years later, in 1917, it was $163,944.75, three and one-half times greater. "In 1917," he said, "the company had come to a period of business somewhat different than in 1910 and 1911; new products were added. Pyrex ware had come in, and the output was more diversified.

"The 10 years since 1917 saw a 66 per cent increase in the average payroll per month and now Corning Glass Works pays out in wages in Corning alone, $271,335.12 or six times greater than in 1907.

"The bulb output forms a large part of our business and we occupy the foremost position in America and I suppose in the world."

The General Electric Company was not satisfied and developed and purchased the rights of the Westlake machines which operated at a lower cost than the local plant could get. General Electric Company, to whom Corning Glass Works sells millions of bulbs for the manufacture of incandescent lamps, also has its own bulb manufacturing plants.

"Then came the time," the speaker continued, "when it was necessary to make a decision. We had to go along with the evolution of the business and adopt machines which would allow us to compete. In 1919 the General Electric Company made 33⅓ of its bulbs by hand, while with the automatics 66⅔ per cent were turned out. In the same year Corning Glass Works was making 43 per cent by hand and 57 per cent by the type E machine. In 1923 the General Electric Company was making 97⅔ per cent of the bulbs with machines and two and one-third by hand while the glass works made 25 per cent by hand, 57 per cent with the semi-automatics and 18 per cent with the automatics.

"At this point Corning Glass Works purchased the General Electric factory at Central Falls. In December, 1923, we would have been confronted by a big loss had we not accepted the evolution of business which forced us to that decision. The automatic had been developed to the point where the General Electric Company could produce its entire bulb requirements in one less plant than it required the previous year, at an increased production with lower costs. Under these circumstances we had no choice of policy.

"In 1925 the glass works machine production was 75 per cent of the total and last year it was 89 9/10 per cent and the balance by semi-automatic and hand."

Mr. Falck then pointed out how the local plant had developed new products, etc., and that this had meant a change in the character of the work.

Safety Banquet Held by Pittsburgh Plate

Works Numbers 4 and 5 of the Pittsburgh Plate Glass Company held their first annual safety banquet at Ford City, Pa., on March 5. About 270 were in attendance. After an excellent dinner the meeting was called to order by C. E. Ralston, Safety Director of the Company, who spoke of the fine work for safety accomplished throughout the Company's plants, stating that seven of the eleven plants had clear records for the month of February and that for the preceding 23 months, Works No. 6, at Charleroi, had not a single lost time accident case. Superintendent Harry A. Reynolds described the development of the safety idea at Works No. 4. Four years ago this plant alone had more lost time accidents than in all of the Company's plants during the year 1926. Up to the time of the meeting, only two minor accidents had occurred in this No. 4 plant since the first of this year.

A. B. McClure, superintendent of Works No. 5, and J. S. Dodge, the Company's insurance manager, made interesting addresses, Karl Core, superintendent of the construction department, Dr. I. E. Ambler of the health department, both spoke briefly. Among others who gave short talks were: John Hatfield, safety director of Works No. 6, Charleroi; Thomas Donoghue, safety engineer Works No. 1. Creighton; Henry Holley, safety inspector Works No. 5; Charles Stewart, chief of the Pittsburgh Plate Glass Company fire department; John Hobaugh, safety inspector Works No. 4; William Watson, assistant superintendent Works No. 5, John Fisher, assistant superintendent Works No. 5; George Brown, assistant superintendent Works No. 4; Henry J. Linder, assistant superintendent Works No. 5; M. C. David, grinder foreman, Works No. 5; H. K. Dresher, assistant superintendent Works No. 4, D. F. Cannon, assistant superintendent Works No. 4 and Fulton Green. Fred Alger of the West Penn Power Company and R. E. Vanatta, safety directory, Columbia Chemical Company, Barberton, O., also gave brief talks.

Glass Attracts Attention at Architectural Show

Several notable displays of glass contributed materially to the attractiveness of the Architectural Exhibition, the first of its kind, which closed March 5 after a successful run at the Grand Central Palace, New York.

Among the hundreds of exhibits, ranging from architects' designs for structures of many kinds, sculptures, bronzes, house furnishings and decorations, to plain building materials, fittings and equipment, the exhibit of the "Celestialite" division of Gleason-Tiebout Glass Company of New York, of which R. D. Cressman is manager, featuring their well known lighting ware, stood out conspicuously for simplicity and beauty. It consisted of a circular-shaped room with a pointed arch ceiling, decorated in black and gold and having a pedestal in the center bearing an illuminated glass globe and at the sides, several fine examples of opalescent bowls arranged with lights behind them to bring out their attractive designs and good illuminating qualities. High up over the center a "Celestialite" fixture of very fine design was suspended.

Another exhibit that attracted more than its share of favorable attention was that of the Corning Glass Works, Corning, N. Y., who showed products of their Steuben division works, including table ware, glass tiles, opal ware, decorative pieces and illuminating glass of original design. Many of the visitors were surprised to learn that such artistic and well wrought glassware, comparable with the products of famous European artists, is being produced commercially in this country.

A series of very fine stained glass windows by American artists, to be installed at an early date in a New York church was also the object of much admiration.

Pittsburgh Section Meets with American Chemical Society

According to the annual custom a joint meeting of the Pittsburgh Sections of the American Chemical and American Ceramic Societies was held Thursday evening, March 17, 1927, at the Pittsburgh Station, United States Bureau of Mines.

After a pleasant dinner and an hour of industrial motion pictures, two interesting papers were given by Stuart M. Phelps, Director of Research and Tests, American Refractories Institute and E. J. Casselman, Industrial Fellow, Mellon Institute of Industrial Research, respectively on "Recent Developments in Refractories Technology" and "Refractories in the Glass Industry."

Mr. Phelps, who is an authority on refractories, described new refractory products, innovations in manufacturing, and testing procedures in the light of the technical requirements of both the producer and the user of refractories. He especially emphasized on the chemical composition of refractory raw products, the factors

of destruction of refractories, and the requirements for satisfactory service.

Mr. Casselman, an expert on glass factory refractories, dealt with the types of heat-resisting materials used in glass-making, how they are employed, their defects, and what research has been done and is trying to accomplish in improving them. Permeability of various refractories to glasses was stressed as an important factor in their ultimate service.

Simplification of Milk Bottles

A joint standing committee of the Division of Simplified Practice, Department of Commerce, met at New York on February 8 to reconsider the action taken on September 8 with regard to overall height and body diameter of the half-pint bottle. After some discussion regarding diameters and weights, a revised recommendation was adopted as follows: "In accordance with the unanimous action of the joint conference of manufacturers, distributors and users of milk bottles, and further amended by the joint Standing Committee at its meetings in New York City on September 8, 1926, and February 8, 1927, the United States Department of Commerce, through the Bureau of Standards, recommends that in respect to bottles used in the sale of milk and cream, the quarter-pint size be eliminated." Also definite sizes, capacities, and dimensions of the quart, pint and one-half pint bottles were recommended. One size of cap was considered sufficient for all requirements.

These revised recommendations are effective March 1, 1927, subject to regular annual revision by the joint conference of the two organizations.

Trademarks "Kryolith"

Trademarks have been granted to the Pennsylvania Salt Manufacturing Company, Philadelphia, Pa., as follows: Reg. No. 223,428, "Kryolith" issued February 1, 1927, and Reg. No. 224,276, "Greenland Kryolith" issued February 22, 1927.

Since 1865 the Company has had the exclusive right to import from Greenland the material known as "kryolith," and during that entire period has been the sole importer. They have always marketed the imported cryolite with the distinctive trademark "Kryolith" or "Greenland Kryolith" and have advertised and billed it under these names.

The company states that the trademarks have been used for such a long period that they have become well and favorably known to the trade, and are of great value and that they have been registered to protect the company's rights.

Promoters of Fraudulent Stock Sent to Jail

Twelve men convicted more than three years ago of fraud in connection with the stock promotion scheme of the Crager glass casket system, have just been declared legally convicted by the United States Circuit Court of Appeals at New York to which they had appealed, and will be forced to serve their sentences in jail. The men are George J. Kaplan, Herman Lieber, Henry Kahn, Louis Cohen, David Palter, Robert Wallach, Alfred Goulson, Joseph Shaw, Alfred Bleau, Raymond Wilson, Jack Block and Joseph E. Dorn. They received sentences ranging from two months to one year and a day.

The glass casket case resulted in Gaston B. Means, one time agent of the Department of Justice, being indicted and imprisoned for conspiracy to obstruct justice.

Plate Glass Production

Figures issued by P. A. Hughes, secretary of the Plate Glass Manufacturers of America covering plate glass production for the month of January, 1927, show a total of 8,483,863 square feet, which was a slight improvement over the previous month's production, December, 1926, of 7,344,361 square feet, but does not equal the production of January, 1926, which was 10,728,677 square feet.

Plate glass production for the month of February, 1927, totalled 9,789,734 square feet which is about one and a quarter million square feet more than was produced in January, 1927. It does not, however, equal the production of February, 1926, which was 10,543,757 square feet.

Changes in Import Classifications

Beginning with January 1 this year the classification for imports of cylinder, crown and sheet glass has been changed in the Monthly Summary of Foreign Commerce of the United States issued by the Bureau of Foreign and Domestic Commerce, Department of Commerce, Washington, D. C., to record separately the figures covering unpolished cylinder glass in cases weighing less than 80 pounds, and those weighing 80 pounds or over. Plate glass is now separated into two items: "polished, unsilvered," and "other plate glass." The summary of imports as well as exports for the month of January, 1927, and for the six months ending December, 1926, is given as usual, on the last text page of this issue.

Eastern Distributors to Discuss Tariff.

The next meeting of the Eastern Division of the National Glass Distributors Association will be held at 10:30 a. m. on April 7 in the Blue Room of the Hotel McAlpin, New York, followed by a luncheon at 1:00 p. m. A. D. Dwelle will preside. Carl F. Doerr, secretary of the division, has announced that one of the most important matters coming up for discussion at this meeting is the tariff on plate glass which will have a public hearing by the United States Tariff Commission beginning May 9.

Refractories Institute Spring Meeting

The American Refractories Institute will hold its spring meeting on Wednesday and Thursday, May 18 and 19, at the Hotel Traymore, Atlantic City. The first day will be taken up by a business and technical session, program for which is to be announced at a later date, and on the second day there will be a golf tournament.

New Glass Factory for Sweden

A glass plant as an adjunct of a blast furnace and a by-product coke works is the somewhat novel tie-up planned by the Oxelosunds Jarnverksaktiebolag, Oxelosund, Sweden. According to the *Iron Age*, the glass plant, which will have five Fourcault units, with an annual capacity of 7,500 tons, will be fired by surplus coke oven gas.

Re-Elect Officers

The National Association of Manufacturers of Pressed and Blown Glassware at a meeting in Pittsburgh on March 8, re-elected the following officers: E. J. Barry, president; C. B. Roe, vice-president; John Kunzler, secretary-treasurer; Charles E. Voitle, assistant secretary. Preliminary to the annual wage conference on July 20 at Atlantic City, a conference will be held at the Marlborough-Blenheim Hotel on July 18.

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Window Glass Decision Appealed

The Window Glass Machine Company and the American Window Glass Company are reported to have appealed from the decision of Judge D. C. Westenhaver of the District Court, Cleveland, Ohio, dismissing their suits against the Sandusky Glass Manufacturing & Supply Company, Sandusky, Ohio. The suit alleged infringement by the latter company of the Lubbers window glass machine patents.

Corporation Reports

Pittsburgh Plate Glass Annual Report

The annual report of the Pittsburgh Plate Glass Company for the year 1926 showed net earnings of $10,016,947, after deductions for depreciation, depletion and obsolescence amounting to $4,135,160, and for estimated Federal taxes on income the sum of $1,450,000. Federal income taxes paid in 1926 on 1925 earnings amounted to $1,616,253. Cash dividends paid in 1926 amounted to $8,854,056. Surplus Account at January 1, 1927, was $33,108,036.

The report of W. L. Clause, chairman of the board of directors, and Charles W. Brown, president, included the following:

The net expenditures for additions and improvements, after giving credits for sales of displaced equipment, and depletion of coal and sand mines, amounted to $8,000,396.18. The principal

items making up this aggregate sum included the balance of cost of construction of the second unit of the continuous process plate glass plant at Creighton, Pa., which was completed and placed in successful operation last July and the completion of electrical power equipment of the Crystal City plate glass plant.

The consumption of plate glass in this country for 1926 approximated 150,000,000 feet. Since the close of the war the plate glass industry has experienced an unprecedented expansion due partly to general business prosperity, partly to extraordinary post-war building construction, and partly and more particularly to the enormous demand for plate glass which sprang from the rapid growth of the automobile industry, intensified by the popularity of the closed car, which requires five times the quantity of glass needed for the open car. For several years the demand exceeded the domestic production, and imports of foreign-made glass increased until they amounted to approximately ten times the pre-war importations. Meanwhile domestic production increased, and by the middle of 1926 there was domestic capacity sufficient to supply fully the domestic demand. In face of this, however, large importations continued, causing reductions in prices, which now are about 40 per cent below the selling prices of the first half of the year 1925. Importations in 1926 aggregated over 24,000,000 feet. If the expansion in the automobile industry and building construction is nearing or has reached the saturation point, it follows that further growth, in the near future, of the demand for plate glass from these sources is not assured, and that further expansion in the plate glass business will depend rather on the normal growth of the country and such new uses for the product as may arise or be developed. Lower prices tend to reduce importations, discourage new plant construction, and increase the general demand. New and special products, such as for example our Company's special ⅛-inch plate glass for dwelling houses and our Tapestry glass, promise to provide substantial volume to add to our regular lines.

Window Glass Machine Company Earnings Lower

The regular quarterly dividend of 1¾ per cent on preferred stock of the American Window Glass Machine Company was declared by the board of directors on March 14, but no dividend was voted on the common stock. This was explained by President W. L. Munro, as follows:

"In view of the fact that the earnings of this company from royalties on the sales of glass by the American Window Glass Company during the past quarter did not justify the continuance of the dividend on the common stock, none was declared.

"The operations of the American Window Glass Company's factories continue to be very satisfactory, and show the highest efficiency in the history of the company, but its sales during the first six months of the fiscal year show a considerable decrease from the corresponding six months of the preceding year.

"This was due to the very large increase in the importations of window glass from Europe during the calendar year ending December 31, 1926. Government reports for that year show total imports of window glass from Europe aggregating 81,633,934 pounds, equal to 1,400,000 boxes of window glass, or about one-seventh of the total annual consumption of this country. This was an increase in imports of 78 per cent over those of the preceding year."

General Flat Glass Company

A stockholders' meeting of the General Flat Glass Company was held at Mannington, W. Va., on March 10. Officers were elected for the ensuing year as follows: Howard D. Atha, president; Jo L. Keener, first vice-president; H. E. DeVaughan, second vice-president; C. Walter Prichard, secretary; Chester L. Prichard, treasurer; R. F. Alter, manager; all of whom, together with S. E. Phillips, are members of the board of directors.

Reports were made by various officials describing the good progress being made on the reconstruction of the Company's plant in which a system of making sheet glass similar to the Fourcault process is being installed. H. E. De Vaughan, second vice-president and chief engineer, and designer of the new machine, has applied for patents covering the new features.

The Owens Bottle Company's net profits, after taxes and charges, for the year ended December 31, 1926, are officially estimated at $6,925,000. This will compare with net of $5,051,050, equivalent after preferred dividends to $6.77 a share on the $16,528,225 common stock outstanding at close of 1925. Net profits for 1926 includes profits in excess of $1,000,000 realized from the sale of investments in other companies. However, net profits from operations will show a marked improvement over the results for 1925 or any previous year. Final figures are expected to be ready several weeks before the annual stockholders meeting on April 20 at Toledo.

The Standard Plate Glass Company had its net profits in 1926 reduced, owing largely to declines in market prices of glass and a falling off of demand in the last quarter of the year. Net profits were $79,605 in 1926 compared with $326,178 in the previous year and $861,512 in 1924. At a recent meeting of directors, Joseph Heidenkamp resigned as chairman of the board and Frank E. Troutman, president, was elected to serve in his stead. R. B. Tucker, sales manager, was elected president. The quarterly dividend of 1¾ per cent on prior preference stock was discontinued.

The United States Glass Company report for the year ended December 31 shows that net profit from operations after deducting Federal taxes totalled $91,863, as compared with $180,376 in 1925. Net addition to surplus in 1926 was $122,483, as against $178,336 in 1925. The debt of the company has been reduced in notes payable to banks to $270,000. Capital stock remains at $97,641 shares outstanding or $2,441,025. During 1926 there was expended for new equipment $142,528.

Trade Activities

Kahn Mirror Plate Company, 1512 Clarks Street, St. Louis, Mo., it is reported, has increased its capital to $20,000.

Niagara Glass Company, St. Catherines, Ont., Canada, is erecting an addition to its glass factory at 19 King Street.

The Whittemore Glass Company plant at Dunbar, W. Va., after a short shutdown for repairs, resumed operations on March 27.

The Derry Glass Sand Company plant at Derry, Pa., which has been closed for the past six months, resumed operations early in March.

The Consolidated Lamp & Glass Company, Coraopolis, Pa., has put an additional furnace in operation which will add materially to the output of the plant.

The Hemingray Glass Company, Muncie, Ind., is erecting a two-story brick office building to replace the one recently destroyed by fire with a loss of $15,000.

The Artistic Lighting Equipment Association has moved its offices from Cleveland, O., to New York City and is now located in Room 711 of the Graybar Building, 420 Lexington Avenue.

It is reported that at a recent meeting of the stockholders of the **Penn Window Glass Company, Pennsboro,** W. Va., it was voted to dissolve the corporation and liquidation is now in process.

J. Goebel & Company, who state that they have been selling the "only original Grossalmerode clay" since 1865, will be located in their own building at 95 Bedford Street, New York, after May 1st.

The Hazel-Atlas Glass Company, at a recent meeting of the directors declared the regular two per cent quarterly dividend, payable April 1st, 1927, to the stockholders on record at the close of business March 22, 1927.

The C. A. Bochert Glass Decorating Company, whose plant is adjacent to the Louie Glass Company's factory at Weston, W. Va., have begun operations in their new decorating plant, using blanks supplied by the neighboring factory.

The Radiant Glass Company, Fort Smith, Ark., which had been closed since January 1 for necessary repairs, resumed operations early in March and will continue until the summer shutdown, July 1. The plant gives employment to about 200 persons.

Butterworth Bros., Ltd., Manchester, England, through L. Milner Butterworth, Director, announce that F. R. Barlow

& Sons, Ltd., Commerce House, Flinders Street, Melbourne, have been appointed their sole agents for the commonwealth of Australia.

Baker Brothers Glass Company, Okmulgee, Okla., have taken possession of the Sunflower Glass Company's plant at Sapulpa, Okla. Work of getting the factory in order for operation is under way and, according to J. E. Baker, it is expected that the plant will start up about May 1.

The Acme Glass Company, Lumberport, W. Va., which recently purchased the property of the Mound City Glass Company at a court sale for $20,000, has been incorporated with an authorized capital stock of $100,000 by Vance L. Hornor, J. H. Knight, James M. Guiher, E. P. Boggess and Philip Steptoe.

Greiner Glass Manufacturing Company, Inc., 1603 Metropolitan Avenue, Brooklyn, N. Y., announce that in addition to their regular line of round crystal and opal glass rods they are now manufacturing square opal glass rods, ⅞ inch in diameter and up to 42 inches in length, and round black glass rods, 1 inch in diameter up to 48 inches in length.

The Ohatchie Glass Manufacturing Company of Alabama have been reported as preparing to erect a plant for making bottles, but according to C. R. Bricken of Montgomery, Ala., the project is still in a formative stage. Mr. Bricken states that the company owns millions of tons of 99.57 per cent pure silica sand, an estimate based on the statements of state geologists and other experts.

The Cameron Glass Company, Cameron, W. Va., states that their plant is not completely closed down as reported, but that the lantern and globe department is working as usual, as well as six hand-lamp chimney shops out of the usual twenty-four. The company reports that while present conditions necessitate a curtailment of operations they have enjoyed a very good winter.

The Hill Clutch Machine & Foundry Company, Cleveland, O., recently appointed Charles C. Phelps, 473 Getty Avenue, Paterson, N. J., as sales engineer for the Metropolitan New York and northern New Jersey district. The manufacture of the Hill Clutch Machine & Foundry Company includes everything for power transmission such as shafting, couplings, bearings, clutches, pulleys, sheaves, belt tighteners, speed transformers, agitators, gears, and sprockets.

A. Loriaux, president and general manager of the Loriaux Glass Company, Fredonia, Kans., has resigned. The new officers of the company are: B. E. LaDow, president; G. E. Klock, vice-president, secretary and treasurer, and J. E. Loriaux, vice-president and manager. The directors, in addition to the above, are: W. D. Pratt, W. H. Wildes, H. P. Heiss and A. Loriaux. The Company is making extensive repairs to the plant and experts to resume operations about May 1st.

The Root Glass Company, Terre Haute, Ind., through Ames. Emerich & Company, Boston, Mass., is offering a new issue of $1,000,000 first (closed) mortgage 6 per cent serial gold bonds to yield from 5.10 to 6 per cent, according to maturity. The first block of $75,000 becomes due in 1928 and amounts maturing increase by $5,000 in 1933 and by $5,000 annually to 1937, when the remainder of $125,000 falls due. The company is one of the leading concerns manufacturing bottles for the beverage trade, and its assets applicable to these bonds total $2,536,975. Company's average annual net earnings for 3½ years to January 31, 1927, totaled $519,966, or over 8.6 times the maximum annual interest charges on this issue.

The Roessler & Hasslacher Chemical Company, of New York, are distributing a very interesting and useful color harmony chart which has been prepared especially for the ceramic industries, that should prove a valuable asset to any manufacturer in whose products color is or may be involved. This color chart is of convenient size, tells what colors to use and how to use them. It describes color terms, color schemes, decorating suggestions, harmony in color, in a clear, interesting manner. By means of a disk wheel of colors, over 1,000 combinations of color are given. Separate charts covering glass colors for the glass industry, overglaze and underglaze colors for pottery, tile and clay industries, enamel oxides for the enameling industry, have been printed and are available to those requesting same.

Industrial Publications

Bethel Feeders. Bethel Engineering Company, Huntington Park, Cal. A four-page folder describing the features of the Bethel feeder. The standard size is used for producing articles weighing from 2 to 26 ounces, the small size from ¾ of an ounce to 8 ounces, and the large size from 20 to 60 ounces. Illustrations are given of the feeder and also an installation of one of them in connection with a Lynch Model LA blowing machine.

Pyrex Industrial Glass Products. A 7 x 10 inch, 20 page booklet issued by the Corning Glass Works, Corning, N. Y., the largest manufacturer of technical glassware in the world, describes the properties and characteristics of Pyrex industrial glass products and illustrates a large line of laboratory glassware, including: power line insulators, tubing and condenser tubing, locomotive headlights and many similar products. Technical data on the composition, stability, resistance to sudden cooling, softening temperatures, and heat transfer are given. The interesting fact is stated that when in 1886 Thomas A. Edison sought to put into practice his conception of the incandescent electric lamp, Corning Glass Works solved the then difficult problem of producing a bubble of thin glass to enclose a filament and maintain a vacuum around it. It is also pointed out that this company pioneered in the development in railroad signal glasses and lenses. Other special glasses are "Noviweld," to protect the eyes in arc welding, "Daylite" glasses for eye strain, Pyrex household utensils, etc. The company offers the services of its trained engineers to develop special products in glass.

What Our Advertisers Are Doing

The Chapman-Stein Furnace Company, Mt. Vernon, O., has contracted with the Zihlmann Glass Company, of Cumberland, Md., to furnish one of their standard 60 x 100 inch recuperative type day tanks. The recuperator for this type of tank is built with the standard Chapman-Stein refractory tile but is all above the ground and is so built as to eliminate the necessity for a separate stack. The company also, a short time ago announced that the Babcock and Wilcox Company has placed a contract with them for a refractory tile recuperator to be used in connection with a glass melting tank which is being built for Turner Brothers Company, Terre Haute, Ind. They desire to obtain some very high temperatures in this tank for the purpose of reducing the melting time of the glass.

Personals

Roy A. Blunt of the Corning Glass Works organization has resigned to become manager of the Buck Glass Company's plant in Baltimore, Md.

J. Roy Helm, who for the past seven years has been sales manager of The Edward Ford Plate Glass Company, Rossford, O., has tendered his resignation to take effect May 1. Mr. Helm will be succeeded by George P. MacNichol, treasurer, who will serve in both capacities.

W. H. Donner, president of the Donner Steel Company, and director of the Mellon National Bank, Pittsburgh, was elected to the board of directors of the United States Glass Company, Pittsburgh, at the annual meeting of that company, on March 16, at which time Charles E. Willock was re-elected. Mr. Donner succeeded Ernst Nichol and M. B. Goff.

Walter Butterworth, of Butterworth Bros. Ltd., Manchester, left England on March 10 for a long health cruise in the Mediterranean. Among other places he will visit Monaco, Naples, Sicily, Cairo and Constantinople. Mr. Butterworth is president of the Society of Glass Technology, and a member of the executive committee of the Glass Research Delegacy, which is the governing body of the Sheffield University Glass Department.

H. J. Heintzelman, for many years president and general manager of the Monongah Glass Company, Fairmont, W. Va., has retired from active management. The Monongah Com-

pany, which has been in continuous operation since its organization by Mr. Heintzelman in 1904, was recently merged with the Turner Brothers Company, Terre Haute, Ind., and the Woodbury Glass Company, Winchester, Ind., a new corporation known as the Turner Glass Company being formed to act as the holding company. The three concerns will retain their present names and operate individually, but will be under the control of the holding company. **R. T. Cunningham,** for many years secretary-treasurer of the Monongah Company, has also retired.

Recent Deaths

B. N. McCoy

B. N. McCoy, a pioneer in the window glass industry, died at his home in Kane, Pa., at the age of 77. Mr. McCoy was one of the first window glass manufacturers in Western Pennsylvania and in 1891 went from Pittsburgh to Kane where he established the B. N. McCoy Window Glass Company, which later became a part of the Consolidated Window Glass Company and finally merged with the Interstate Window Glass Company.

George L. Wellington

George L. Wellington, founder of the old Wellington Glass Company, manufacturers of illuminating glassware, at Cumberland, Md., died at his home in that city on March 20 at the age of 75. Mr. Wellington was also president of the Potomac Glass Company, Cumberland, until his retirement from active connection with the glass industry about six years ago.

John Taylor Adams

John Taylor Adams, aged 98, pioneer glass manufacturer and former resident of Pittsburgh, died at his home in Frankton, Ind., on March 16. Mr. Adams, who was born in Wading River, N. J., entered the glass business when a boy and at the age of 18 went to Pittsburgh and was connected with the Chambers Window Glass Company for 30 years. He then went to Frankton and organized the Frankton Window Glass Company which he served as president for many years, until it was absorbed by the American Window Glass Company, after which he was retained as manager of the Frankton plant. Mr. Adams retired about 15 years ago. He was survived by his wife, four daughters and a son.

Coming Meetings

THE SOCIETY OF INDUSTRIAL ENGINEERS' 14th annual convention will be held on May 25, 26 and 27 at the Hotel Stevens, Chicago. "The Principles of Effective Management and their Relation to Industrial Engineering" will be the main theme.

THE AMERICAN CERAMIC SOCIETY'S next annual meeting will be held at Atlantic City, N. J., during February, 1928.

THE STAINED GLASS ASSOCIATION OF AMERICA will hold its twenty-sixth annual meeting in St. Louis, Mo., on June 27, 1927.

THE GLASS CONTAINER ASSOCIATION will hold its annual meeting at the Hotel Marlborough-Blenheim, Atlantic City, on May 5 and 6.

THE AMERICAN REFRACTORIES INSTITUTE'S spring meeting will be held this year on May 18 and 19 at the Hotel Traymore, Atlantic City, N. J.

NATIONAL GLASS DISTRIBUTORS ASSOCIATION. EASTERN DIVISION. Will hold its next meeting at the Hotel McAlpin, New York, on April 7.

Inquiries Received

For Further Information Address THE GLASS INDUSTRY

365. I would like the names of manufacturers of clock glasses, about 3 inches in diameter. (Feb. 28.)

366. Can you advise where glass balls for lighting rods can be obtained. (Mar. 23.)

367. We have a foreign inquiry for glass blowing machinery for making window glass. (Mar. 18.)

368. I have the impression that there is an American glass manufacturer who is now in quantity production of a glass that will pass an appreciable amount of the ultra violet rays of the sun. Could you tell me whether or not I am correct in this and give me some idea of the cost of this glass? (Mar. 8.)

Glass Stock Quotations

PITTSBURGH STOCK EXCHANGE, MARCH 24, 1927

	BID	ASKED	LAST
American Window Glass Machine, com.	....	....	41
American Window Glass Machine, pfd..	....	....	75
American Window Glass, pfd.....	....	....	108
United States Glass.....	....	....	15
Pittsburgh Plate Glass, com.....	....	....	248
Standard Plate Glass, com.....	....	....	3
Standard Plate Glass:			
Preferred cumulative	....	....	11
Prior preferred	....	....	60

TOLEDO STOCK EXCHANGE, MARCH 28, 1927

	BID	ASKED	LAST
Owens Bottle Machine, com.....	115¼	117	115
Libbey-Owens Sheet Glass, com.....	129	130	129
Libbey-Owens Sheet Glass, pfd.....	115	....	115

WHEELING STOCK EXCHANGE, MARCH 29, 1927

	BID	ASKED	LAST
Hazel-Atlas	48	48½	48½
Imperial	....	....	72
Fostoria	165	....	150
Central	....	....	75

READERS WANTS AND OFFERS

Wanted—Young man with engineering or operating experience in glass manufacturing plants, to sell, install and service electric pyrometers, recording instruments and automatic temperature control equipment for use in the glass industry. Candidates must be free for quick transfers and unlimited travelling throughout the United States. Highest character references required. Young single man preferred. Write stating age, education, experience and salary desired. Address Salesman, care THE GLASS INDUSTRY, 50 Church Street, New York.

Wanted—Pyrometers—Late model single and also duplex Brown Instrument Company's recording pyrometers in good condition. State price. Address. Pyro, care THE GLASS INDUSTRY, 50 Church Street, New York.

For Sale: Journal of the Society of Glass Technology. December, 1919; March and December, 1923. Complete sets of 1920, 1921 and 1922. Price (unbound) $22.00. Address Box P, care THE GLASS INDUSTRY, 50 Church Street, New York.

Wanted January Copies: Copies of the January, 1927, issue of THE GLASS INDUSTRY are desired. Also, August, 1921; January and February, 1923; March and July, 1924. State terms. Address: THE GLASS INDUSTRY, 50 Church Street, New York.

Current Prices of Glass-Making Materials

March 25, 1927

Quotations furnished by various producers, manufacturers and dealers.

		Carlots	Less Carlots
Acid			
Citric	lb.	.43½	.43½
Hydrochloric (HCl) 20° tanks, per 100 lb.	lb.	.95-1.05	..
Hydrofluoric (HF) 60% (lead carboy)	lb.	..	.13½
52% and 48%	lb.	.10	.11½
Nitric (HNO_3) 38° carboy ext. Per 100 lb.	lb.	5.50	5.75
Sulphuric (H_2SO_4) 66° tank cars	ton	15.00-16.00	..
Tartaric	lb.	.32-.33½	.32-.34½
Alcohol, denatured	gal.	..	.40½
Aluminum hydrate ($Al(OH)_3$)	lb.	.05	.05½
Aluminum oxide (Al_2O_3)	lb.	..	.07
Ammonium bifluoride (NH_4) FHF	lb.	..	.21-.22
Ammonia water (NH_4OH) 26° drums	lb.	..	.03
Antimony, metallic (Sb)	lb.	..	.14½
Antimony oxide (Sb_2O_3)	lb.	..	.16½
Antimony sulphide (Sb_2S_3)	lb.	.15	.16½
Arsenic trioxide (As_2O_3) (dense white), 99%	lb.	.03¾	.04
Barium carbonate ($BaCO_3$)			
Precipitated	ton	53.00	58.00
Natural, powdered, imported	ton	48.00	50.00
Barium hydrate ($Ba(OH)_2$)	lb.	..	..
Barium nitrate ($Ba(NO_3)_2$)	lb.	.08¼	.08½
Barium selenite ($BaSeO_3$)	lb.	..	..
Bone ash	lb.	.05	.05½
Borax ($Na_2B_4O_7 10H_2O$)	lb.	.04	.04¼-.04¾
Boric acid (H_3BO_3)	lb.	.08	.08½-.09¼
Refined	lb.	.08-.09½	.08½-.10¾
Cadmium sulphide (CdS)—			
Red	lb.	..	1.20
Orange	lb.	..	1.10-1.25
Yellow	lb.	..	1.20-1.40
Chromium oxide (Cr_2O_3)	lb.	.27	.28
Cobalt oxide (Co_2O_3)			
In bbls.	lb.	..	2.10
In 10 lb. tins	lb.	..	2.20
Copper oxide			
Red (Cu_2O)	lb.	..	.30
Black (CuO)	lb.	..	.25-.30
Black prepared	lb.	..	.30
Cryolite ($Na_3Al\ F_6$) Natural Greenland Kryolith)	lb.	..	.09½-.09½
Artificial or Chemical	lb.	..	.09½
Epsom salts ($MgSO_4$) (imported) Per 100 lb.		1.20	1.30
Feldspar—			
100 mesh	ton	11.00-20.00	16.00-22.00
80 mesh	ton	13.50	..
40 mesh	ton	12.50	13.50
Flourspar (CaF_2)—			
Powdered white, 95-98%	ton	32.50	41.50
Formaldehyde	lb.	.11¼	.11¾
Graphite (C)	lb.	..	.04-.07
Iron oxide—			
Red (Fe_2O_3)	lb.	..	.02-.03
Black (FeO)	lb.	..	..
Kaolin (f.o.b. mine)	ton	10.00	..
English, lump, f.o.b. New York	ton	13.00-23.00	..
Kryolith (see Cryolite)			
Lead chromate ($PbCrO_4$)	lb.	..	..
Lead oxide (Pb_3O_4) (red lead)	lb.	.10¾	.10¾-.11
Litharge (PbO)	lb.	.10¼	.10¼-.10½
Lime—			
Hydrated ($Ca(OH)_2$) (in paper sacks)	ton	12.50	..
Burnt (CaO) ground, in bulk	ton	9.00	..
Burnt, ground, in paper sacks	ton	11.00	..
Burnt, ground, in 280 lb. bbls.	Per bbl.	2.15	2.30
Limestone ($CaCO_3$)		2.00	..
Magnesia (MgO)—			
Calcined, heavy (in bbls.)	lb.	.04	.04½
light (in bbls.)	lb.	.22	.24
extra light (in bbls.)	lb.	..	.37
Magnesium carbonate ($MgCO_3$)	lb.	.06	.07½
Manganese 85% (MnO_2)	lb.	.04½	.05
Nickel oxide (Ni_2O_3), black—for nickel content	lb.	..	.35
Nickel monoxide (NiO), green—for nickel content	lb.	..	.35
Plaster of Paris, bags	ton	..	19.00
Potassium bichromate ($K_2Cr_2O_7$)—			
Crystals	lb.	.08¼	.08⅝
Ground	lb.	.11	.12
Potassium carbonate—			
Calcined (K_2CO_3) 96-98%	lb.	.06½	.06¾
Hydrated 80-85%	lb.	.05¾	.06
Potassium chromate (K_2CrO_4)	lb.	..	.27
Potassium hydrate (KOH) (caustic potash)	lb.	.07½	.07⅝
Potassium nitrate (KNO_3) (gran.)	lb.	.05⅞-.06	.06⅛-.06¼
Potassium permanganate ($KMnO_4$)	lb.	.13½	.14
Powdered blue	lb.	..	.24-.26
Rochelle salts, bbls.	lb.	..	.20
Rouge	lb.	..	..
Rutile (TiO_2) powdered, 95%	lb.	.15-.20	.20-.25
Salt cake, glassmakers (Na_2SO_4)	ton	22.00	..
Selenium (Se)	lb.	..	2.10-2.15
Silver nitrate ($AgNO_3$)	oz.	..	.41
Soda ash (Na_2CO_3) dense, 58%—			
Bulk, on contract—Flat per 100 lb.		1.27½	..
In barrels—Per 100 lb.		1.57½	2.40
In bags—Per 100 lb.		1.37½	..
Spot orders—.05 per 100 lbs. higher			
Sodium bichromate ($Na_2Cr_2O_7$)	lb.	.06¼	.06¾
Sodium hydrate (NaOH) (caustic soda)	Per 100 lb.	..	..
Sodium nitrate ($NaNO_3$)—			
Refined (gran.) in bbls.	lb.	.03⅞	.04⅛
95 per cent.	Per 100 lb.	2.65	2.85
Sodium selenite (Na_2SeO_3)	lb.	..	2.35
Sodium fluosilicate (Na_2SiF_6)	lb.	.05	.05½
Sodium uranate (Na_2UO_4) Yellow or Orange	lb.	..	1.25
Sulphur (S)—			
Flowers, in bbls.	Per 100 lb.	3.45	3.80-4.00
Flowers, in bags	Per 100 lb.	3.10	3.45-365
Flour, heavy in bbls.	Per 100 lb.	2.85	3.20-3.40
Tin chloride ($SnCl_2$) (crystals)	lb.	..	.47
Tin oxide (SnO_2) in bbls.	lb.	..	.70
Uranium oxide (UO_3) (black, 96% U_3O_8) 100 lb. lots	lb.	..	1.25-2.25
Zinc oxide (ZnO)	lb.	.06⅛	.07

Monthly Summary of United States Foreign Commerce in Glass

EXPORTS

Corrected to February 24, 1927

	January 1925 Quantity	January 1925 Value	January 1926 Quantity	January 1926 Value	Six Months Ending December 1925 Quantity	Six Months Ending December 1925 Value	Six Months Ending December 1926 Quantity	Six Months Ending December 1926 Value
Glass and glass products (total)	.....	$673,381	.....	$704,177	.....	$4,330,607	.....	$4,735,473
Plate and window glass—								
Window glass, common, box 50 sq. ft.	4,815	23,144	2,350	15,831	10,706	58,173	13,543	87,803
Plate glass, unsilvered, sq. ft.	119,612	27,967	111,780	30,224	829,204	202,826	168,518	77,224
Other window and plate glass lbs.	132,252	19,907	411,961	28,996	1,365,323	153,008	1,843,242	156,356
Glass containers (bottles, vials and jars)	.....	214,202	.....	194,470	.....	1,372,719	.....	1,708,147
Table glassware, plain	.....	110,803	.....	123,957	.....	913,251	.....	844,465
Table and other glassware, cut or engraved	.....	11,521	.....	8,341	.....	89,774	.....	77,962
Lamp chimneys and lantern globes lbs.	205,528	35,500	204,669	48,203	867,393	183,577	865,535	169,085
Globes and shades for lighting fixtures lbs.	145,903	47,869	159,096	52,005	894,516	261,196	898,372	319,044
Chemical glassware lbs.	18,588	17,228	16,649	14,076	116,623	110,262	117,414	105,315
Electrical glassware, except for lighting lbs.	522,089	35,615	170,973	24,212	983,143	132,121	1,645,422	207,031
Other glassware	.....	129,625	.....	163,862	.....	853,700	.....	983,041

IMPORTS

Corrected to February 24, 1927

Glass and glass products	.....	1,394,484	.....	1,385,096	.....	8,794,027	.....	10,629,306
Cylinder, crown and sheet—								
Unpolished dut. lb.	5,358,889	226,377	.....	.....	19,085,224	986,734	41,652,180	1,441,263
Weighing less than 80 pounds per case dut. lb.	.....	.....	3,641,425	98,769	.....	.....	.....	.....
Weighing 80 pounds or over per case dut. lb.	.....	.....	3,481,338	213,397	.....	.....	.....	.....
Bent, ground, beveled, colored, painted, etc., and polished dut.	.....	67,783	.....	43,341	.....	235,719	.....	249,219
Plate glass dut. sq. ft.	2,043,239	626,927	.....	.....	8,333,904	3,153,389	12,690,213	4,259,262
Polished, unsilvered dut. sq. ft.	.....	.....	1,357,126	497,531	.....	.....	.....	.....
Other plate glass dut. sq. ft.	.....	.....	127,369	27,048	.....	.....	.....	.....
Containers—bottles, vials, etc. dut.	.....	18,818	.....	23,571	.....	97,626	.....	106,732
Table and kitchen utensils dut.	.....	3,679	.....	17,655	.....	100,030	.....	81,542
Glassware, cut or decorated dut.	.....	173,958	.....	192,517	.....	1,437,412	.....	1,752,577
Blown glassware, n. e. s.—								
Bottles, ornaments, etc. dut.	.....	41,125	.....	63,907	.....	1,263,477	.....	1,263,986
Bulbs for electric lamps dut.	1,674,473	15,777	1,163,877	11,871	6,356,307	70,817	8,413,465	91,275
Chimneys, globes, shades, etc. dut. No.	.....	77,945	.....	77,884	.....	498,081	.....	500,129
Articles and utensils for chemical, scientific, and experimental purposes dut.	.....	46,848	.....	35,775	.....	239,753	.....	241,139
Other glassware dut.	.....	95,247	.....	81,830	.....	710,989	.....	642,182